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TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

SIGNAL GENERATOR TS-452D/U
AND
SIGNAL GENERATOR TS-452E/U

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HEADQUARTERS, DEPARTMENT OF THE ARMY
OCTOBER 1963

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TECHNICAL MANUAL
No 11-6625-575-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *18 October 1963*

Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual
SIGNAL GENERATOR TS-452D/U
AND
SIGNAL GENERATOR TS-452E/U

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*This manual supersedes that portion of TM 11-6625-283-12P, 20 March 1962, as pertains to maintenance allocation and basic issue items.

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SECTION A
INDEXES OF PUBLICATIONS AND FORMS AND RECORDS

A-1. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

A-2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 75-18/MCO P4610.19B, and DSAR 4500.15.

A-3. Reporting of Errors

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, NJ 07703.

A-4. Administrative Storage

For procedures, forms, and records, and inspections required during administrative storage of this equipment, refer to TM 740-90-1.

A-5. Destruction of Army Materiel

Demolition and destruction of electronic equipment will be under the direction of the commander and in accordance with TM 750-244-2.

A-6. Items Comprising an Operable Equipment

NSN	Qty	Nomenclature, part No., and mfr code	Fig. No
		NOTE **The part number is followed by the applicable 5-digit Federal supply code for manufacturers (FSCM) identified in SB 708-42 and used to identify manufacturer, distributor, or Government agency, etc.**	
		NOTE — Deleted	
6625-00-828-6410		Signal Generators TS-452D/U and TS-452E/U; a signal generator which can be frequency swept to produce a signal suitable for testing FM radio and radar receivers on RF or IF between 5 and 11 mc; operated on 115 vac, 50 to 1600 cps, single phase; approx 19 in. lg x 16 1/4 in. w x 10 in. h; wt 50 lbs which includes:	
		Signal Generator TS-452D/U and TS-452E/U (Basic Component)	
6625-00-243-6886	1	Cable Assembly, Radio Frequency: cord CG-426/U (4 ft lg)	1-1
5935-00-491-4294	1	Connector, Adapter UG-83A/U	
5935-00-823-0639	1	Connector, Adapter UG-255A/U	
5935-00-149-3534	1	Connector, Adapter UG-273/U	
5935-00-392-5640	1	Connector Assembly, Electrical; Adapter UG 1100/U	
6625-00-245-9619	1	Detector, Radio Frequency: R.F. Detector DT-149/U	1-4
6625-00-546-6595	1	Scale, Cathode Ray Tube: Cathode Ray Tube Scale MX-1628/U	1-1

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. This manual provides maintenance instructions for Signal Generator TS-452D/U and TS-452E/U.

1-3. All references to TS-452D/U also pertain to TS-452E/U.

1-4. This manual was written for the maintenance technician. Within the framework of Specification MIL-H-7960A (ASG), to which it conforms, and used in conjunction with T.O. 33A1-8-90-24 (Illustrated Parts Breakdown), it will assist maintenance facilities in troubleshooting and servicing of the signal generator and its components. Other information which may be of value to maintenance personnel appears in the following specifications:

MIL-STD-15	Electrical and Electronic Symbols
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment

1-5. DESCRIPTION.

1-6. The signal generator chassis with front panel attached is housed in a painted sheet-metal instrument case (figure 1-1). Four small protuberances on the bottom of the case—one in each corner—serve as feet. A small hole in the lower left side of the rear of the case provides access to the AGC control on the chassis. Access to the controls of the cathode-ray oscilloscope is provided by a hinged door on the top rear left corner of the case. The door is locked by a snap fastener with a slotted head, requiring a 90-degree counterclockwise turn to open. Three allen wrenches are clipped to the inside of the door.

1-7. The signal generator chassis incorporates the most frequently used operating controls on its front panel (figure 1-1 and 4-1):

a. The 3-inch 3BP1A cathode-ray tube, with a light hood which can be pulled out 5 inches from the front panel;

b. INPUT and R.F. OUTPUT UG290/U receptacles: VERT. AMP., HOR. AMP., MARKER WIDTH, SWEEP WIDTH, SWEEP SPEED, and CENT. FREQ. controls;

c. WAVEMETER BAND-SWITCH, WAVEMETER TUNING control and WAVEMETER FREQUENCY dial;

d. SWEEP OSCILLATOR BANDSWITCH;

e. Eight ATTENUATOR pushbutton switches.

1-8. The attenuator (figure 1-2), which is located at the bottom of the chassis directly behind the front panel (figure 6-1), is a casting with nine rectangular compartments in two layers. Eight of the compartments are for the attenuator sections, and each compartment holds a switch and the series and shunt resistors. The ninth compartment houses the R.F. OUTPUT receptacle. Cover plates at the top and bottom of the casting provide complete shielding of the attenuator. A rigid tube at the rear of the casting supports a coaxial lead for the series connection from the last compartment of the top layer to the first compartment of the bottom layer.

1-9. Except for the cathode-ray tube, wavemeter, attenuator, and sweep oscillator, which are assembled on separate subassemblies, all circuits are assembled directly on the main chassis.

1-10. The cathode-ray tube assembly (figure 1-3) is located at the left of the main chassis (figure 4-3) and comprises the cathode-ray tube and a subchassis at the rear. The cathode-ray tube is surrounded by a magnetic shield over which the metal light hood slides on three rods. Four cathode-ray oscilloscope controls (INTENSITY, FOCUS, VERT CENTER, and HORIZ CENTER) are mounted on the top of the rear subchassis so that they are readily accessible through the access door in the protective case.

1-11. The wavemeter (figure 4-2) is the large rectangular housing in the center behind the front panel. The WAVEMETER, BANDSWITCH, FREQUENCY dial, variable air TUNING capacitor and differentiating amplifier subchassis are housed in the wavemeter casting. The gearing between the TUNING knob and FREQUENCY dial is at a ratio of 20 to 1.

1-12. The detector probe (figure 1-4) consists of a crystal rectifier, input and filtering resistors, capacitors contained in a small cylindrical metal case, and a 5-foot long coaxial cable to which is attached a UG260/U plug for connection to the input jack of the signal generator. Input connection to the probe is provided by two chucks which can hold small wires. A chuck mounted in a clear plastic portion of the probe end piece is in the input connection. The other chuck is the ground connection.

1-13. The sweep oscillator unit (figure 1-5) consists of inductors in a hermetically sealed metal case. A 9-pin electron tube socket is mounted on the top of the case. A UG1094/U receptacle is mounted on the rear of the case. Two coaxial cables, (one of which has a UG260/U plug attached) and four mounting lugs (one in each corner) and six input terminals are located on the bottom of the unit.

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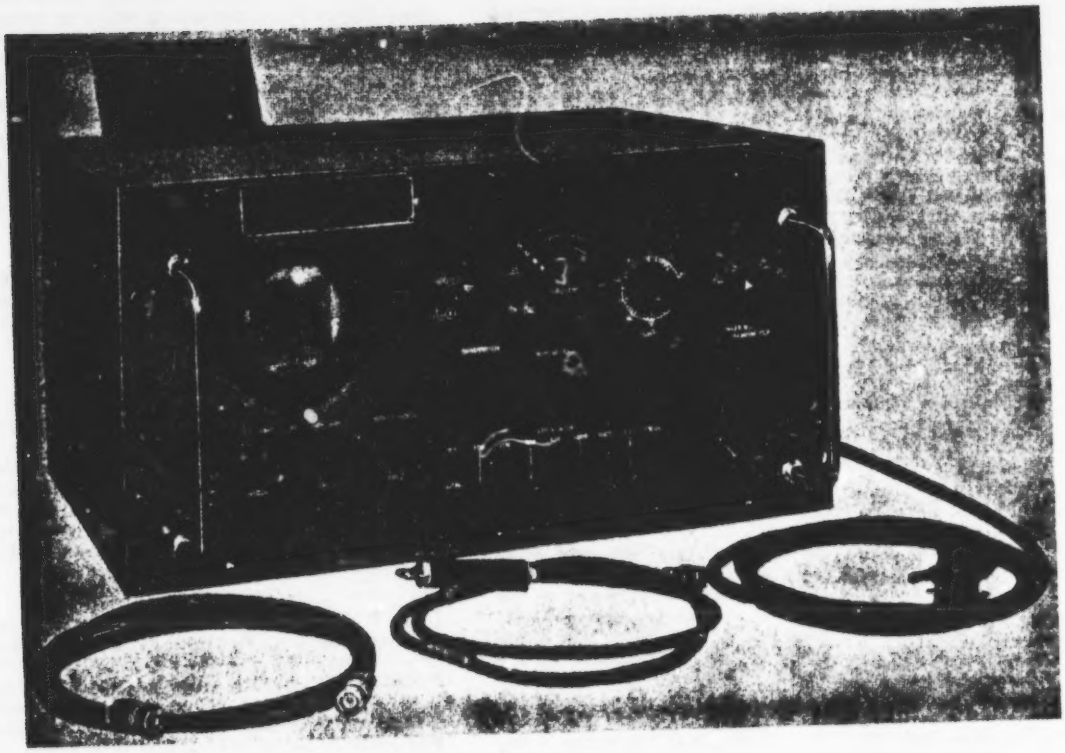

Figure 1-1. Signal Generator TS-452D/U

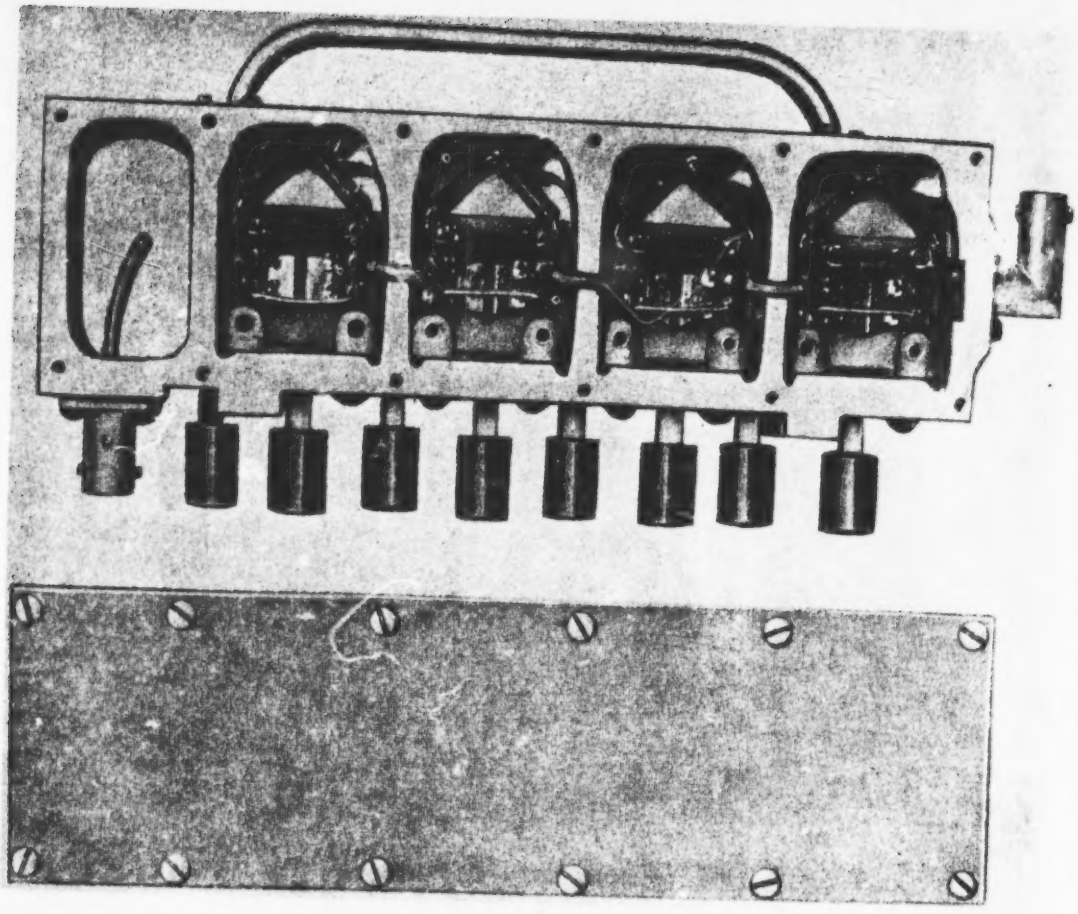

Figure 1-2. Attenuator Unit with Top Cover Removed

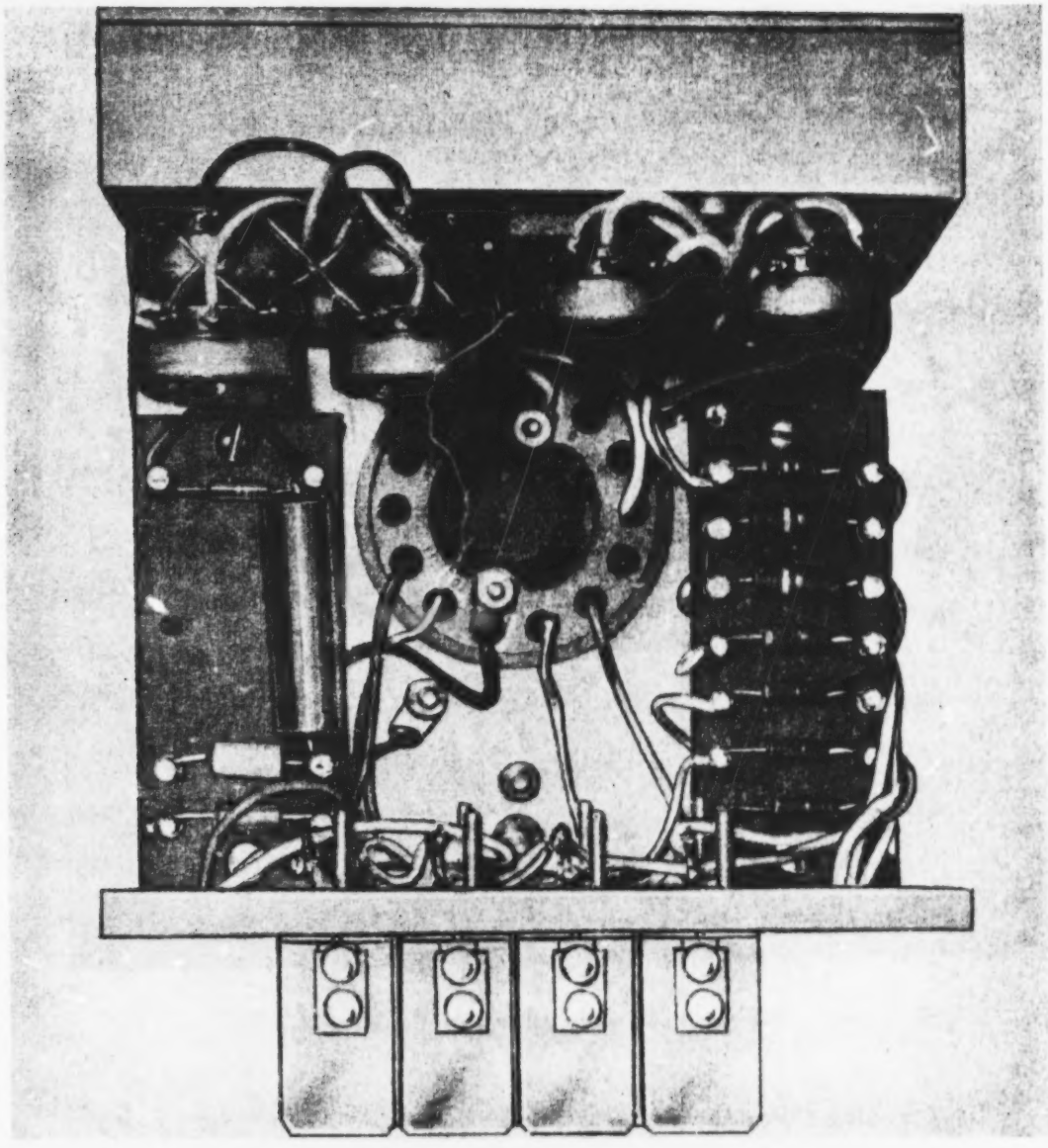

Figure 1-3. Cathode-Ray Tube Assembly

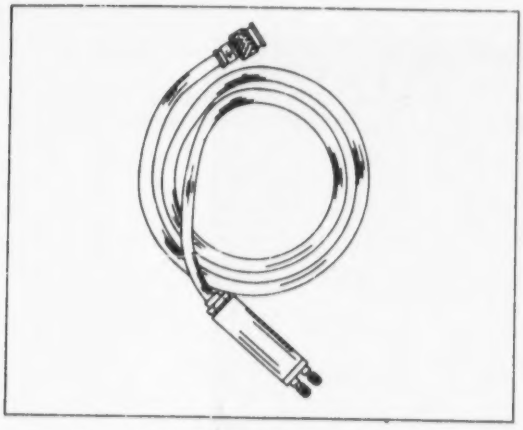

Figure 1-4. Detector Probe DT-149/U

1-14. LEADING PARTICULARS.

1-15. ELECTRICAL CHARACTERISTICS. The electrical characteristics of Signal Generator TS-452D/U are listed in Table I.

1-16. TUBE COMPLEMENT. The tube complement for Signal Generator TS-452D/U is listed in Table II.

1-17. PRINCIPLES OF OPERATION. In the construction and maintenance of communication and radar systems it is frequently necessary to know the exact bandpass characteristics of a particular network or amplifier. The basic method of measuring such characteristics uses a signal generator and a voltage-indicating device or calibrated detector. To perform the measurement, a signal of known amplitude and frequency is fed into the network under examination and the output or response of the network is measured on the detector and recorded. The input signal frequency is then changed without altering the input signal level, and the measurement is repeated.

Table I. Electrical Characteristics

Maximum operating current	0.750 AMP
Equipment operating range	-10°C (-40°F) to 55°C (+131°F)
Frequency range	5 to 100 MC
Frequency bands	5—10 MC 10—20 MC 20—40 MC 30—100 MC
Wavemeter bands	
Bandswitch position A Bandswitch position B Bandswitch position C Bandswitch position D	5—10 MC 10—20 MC 20—40 MC 40—100 MC
Oscillator RF output harmonic content	Harmonic content will be at least 20 db below the fundamental frequency.
Wavemeter accuracy	±0.33%
Oscillator RF output hum modulation	±2% maximum
Vertical amplifier flat frequency response	Within ± 2.5 db from 20 CPS to 20 KC.
Oscillator RF output voltage	Not less than 0.25 volt into a matched load.
Output attenuation available	101 db in 1-db steps.
Output voltage versus attenuator setting	As indicated in figure 6-2.
Output impedance	75 ohms nominal.
Input impedance of probe	2.5 MMF shunted by 470 ohms.
Input voltage required	115 volts ±10%, 50—1600 CPS.
Equipment input power factor	95%

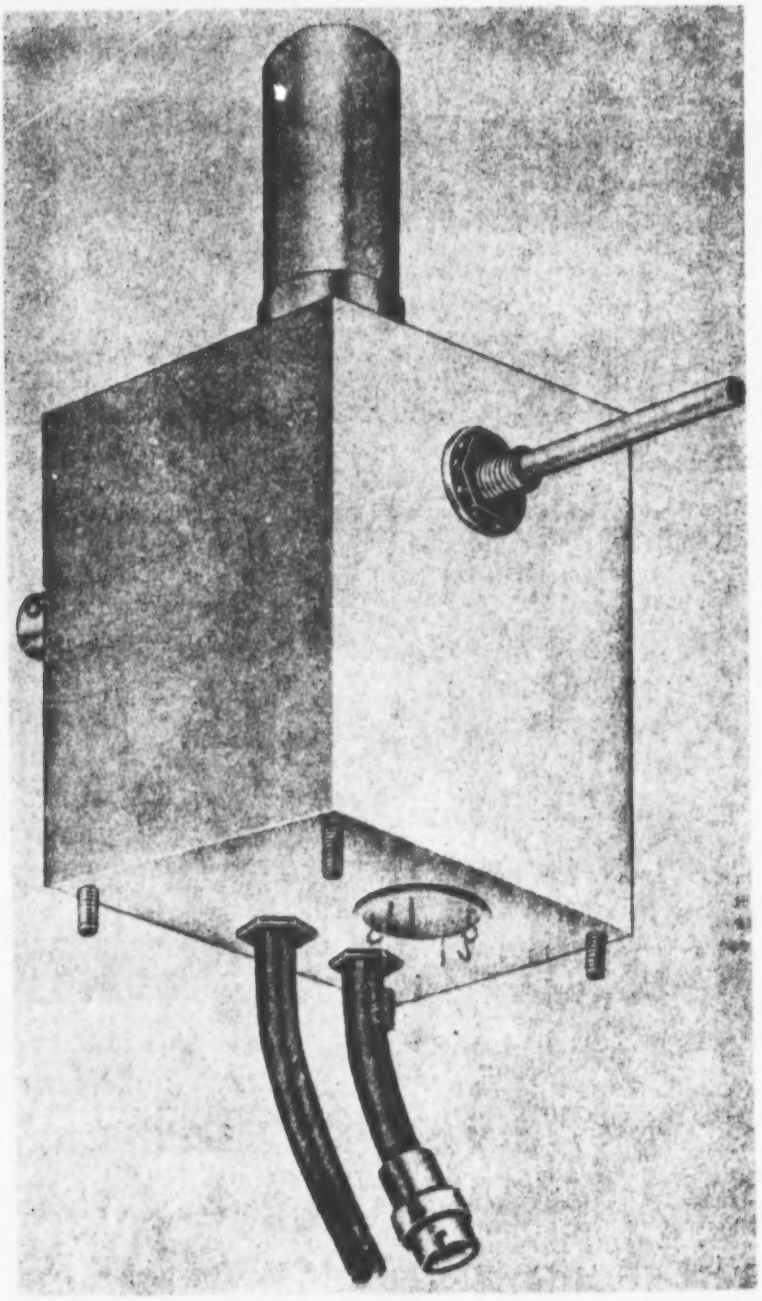

Figure 1-5. Sweep Oscillator Unit

Table II. Tube Complement of Signal Generator TS-452D/U

Quantity	JAN Type Number	Reference Symbol	Function
3	12AU7	V1	Multivibrator
		V2	Integrator/regulator
		V4	Horizontal amplifier
1	12AX7	V3	AGC amplifier
1	6V6GTY	V5	Current driver
1	12AT7WA	V6	Sweep oscillator
2	6SN7WGT	V101	Vertical amplifier
		V102	Same as V101
1	3BP1A	V103	Cathode-ray indicator
1	1B3GT	V104	High-voltage rectifier
2	6X5WGT	V105	Low-voltage rectifier
		V106	Same as V105
2	OD3/VR150	V107	Low-voltage regulator
		V108	Same as V107
2	6SL7WGT	V401	Pulse amplifier
		V402	Same as V401

1-18. By this means it is possible to prepare a record of the response of the network to a constant input signal at any frequency within a desired band. If sufficient points are taken, the data will permit the plotting of a curve that represents, for practical purposes, the response of the network at any frequency within the band.

1-19. Even though only a few points are required, this method is tedious. It is particularly so when used to check adjustment of bandpass networks since the entire series of points must be rechecked after each trial adjustment.

1-20. The Signal Generator TS-452D/U performs the steps required by this measurement and plots a curve showing the response, all within a fraction of a second.

1-21. This generator consists of four basic functional elements:

a. A cathode-ray oscilloscope for the display of frequency versus amplitude (consisting of vertical amplifier and cathode-ray tube circuits);

b. A resonant type wavemeter, which produces a blanking pulse on the screen of the cathode-ray tube for frequency determination,

c. An attenuator for the reduction of RF signal output in calibrated steps; and

d. A sweep oscillator for the production of a constant sine wave radio-frequency voltage at a frequency which is varied over a selected range at a rate approximately 60 to 100 cycles per second.

1-22. The spectrum of the radio-frequency sweep oscillator is from 5 to 100 megacycles in four overlapping ranges (40 percent minimum overlap), permitting observation of a display at any point in this spectrum without end-band effects. Accessories furnished with the unit include an interconnecting coaxial cable and a terminating resistor, in addition to an RF probe. Supplementary adapters permit connection to an equipment under test employing cables of either type N or type BNC coaxial cable connectors. A complete schematic diagram of the signal generator (figure 1-16) will be found at the end of this section.

1-23. BLOCK DIAGRAM. The input signal (figure 1-6), generally obtained from the probe (which rectifies RF signals fed into it), is coupled through the INPUT receptacle to the vertical amplifier and then is applied to the vertical deflection plates of the cathode-ray tube.

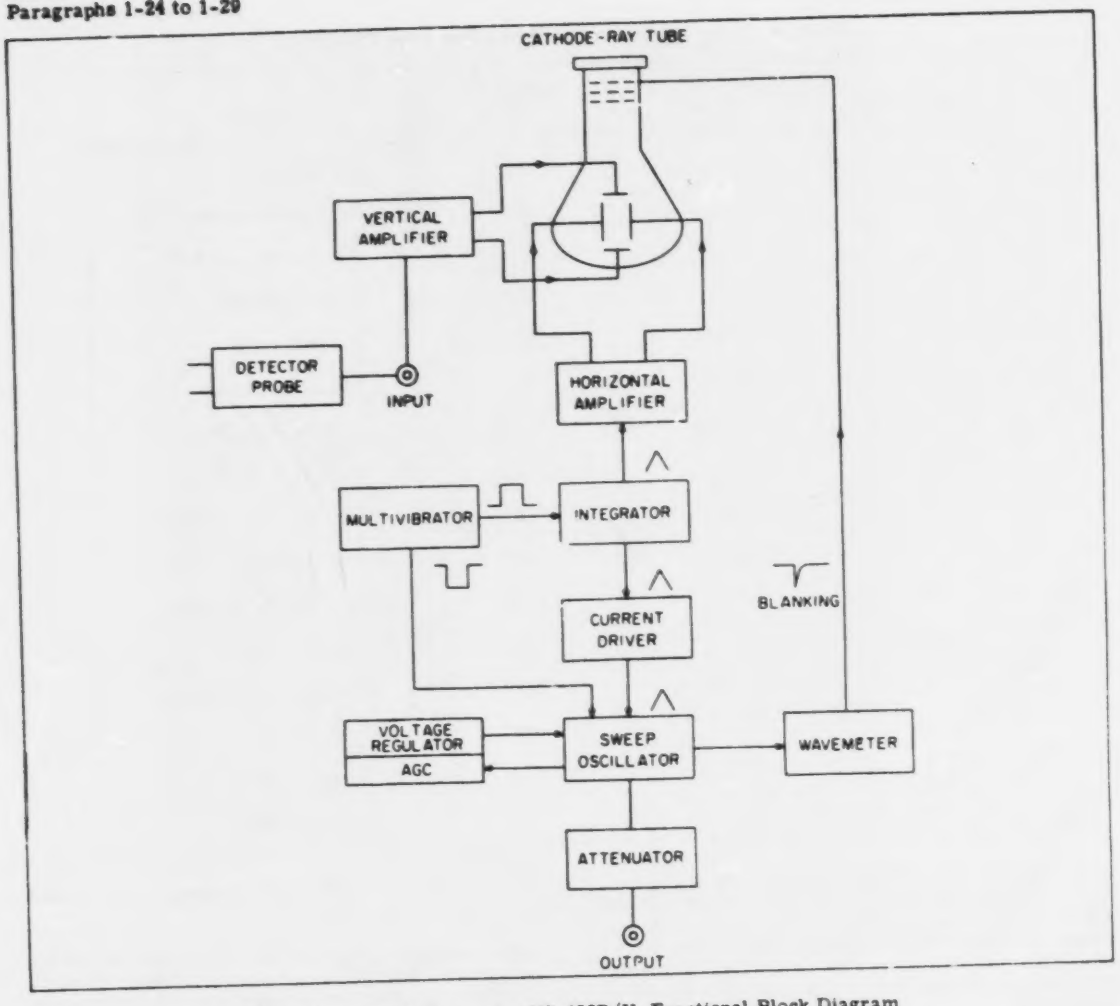

Figure 1-6. Signal Generator TS-452D/U, Functional Block Diagram

1-24. A free-running multivibrator provides two out-of-phase square-wave pulses which are fed into two channels of operation. One output of the multivibrator is applied to an integrator circuit, which in turn provides a sawtooth triangle-shaped voltage which is applied to the horizontal amplifier and current driver. The other output of the multivibrator provides a blanking pulse which is applied to the sweep oscillator.

1-25. One output of the integrator circuit is applied to the horizontal amplifier which amplifies the sawtooth voltage and applies it to the horizontal plates of the cathode-ray tube. The sawtooth voltage also drives the current driver circuit, which in turn causes the sweep oscillator to sweep a segment of the frequency spectrum selected by the sweep oscillator bandswitch.

1-26. It is necessary to cut off the sweep oscillator during the second half of the triangular waveform. Thus, only the leading edge is utilized. The cutting off of the sweep oscillator is done with the blanking pulse provided by the multivibrator. The blanking pulse is a clamped, negative-going square-wave pulse that biases the sweep oscillator to cut-off.

1-27. The sweep oscillator provides three outputs. One output is from a detector circuit that is identical to that of the detector circuit used in the probe. Its output is of opposite phase to that of the detector probe output and is amplified in the AGC circuitry, controlling a voltage regulator. The voltage regulator changes the plate voltage supplied to the sweep oscillator in such a manner as to maintain optimum linearity on the cathode-ray tube display.

1-28. The second output of the sweep oscillator is coupled to the attenuator and appears at the R.F. OUTPUT receptacle.

1-29. The third and remaining output from the sweep oscillator is applied to the wavemeter input.

1-30. The wavemeter input tuned circuit produces a rounded pulse when the oscillator passes through its resonant point. The differentiating amplifier converts this broad rounded pulse into a sharp negative pulse of approximately 50 microseconds duration. This latter pulse is applied to the grid of the cathode-ray tube for blanking purposes. Thus, whenever the RF voltage passes through the resonant frequency of the wavemeter, the negative pulse is applied to the cathode-ray tube grid, interrupting the beam and producing a blank spot in the pattern, so that the frequency of any particular point in the displayed response curve is given on the wavemeter dial.

1-31. The RF output from the unit is terminated correctly with these connections: R.F. OUTPUT receptacle to RF output cable to terminating resistor to detector probe to INPUT receptacle. When it is correctly terminated, a pattern appears on the screen of the cathode-ray tube, as shown at A of figure 1-7. At point 1 the cutoff bias is removed by the cycling of the multivibrator, permitting operation of the sweep oscillator. The voltage thus produced causes the cathode-ray tube beam to move to point 2. During interval 2 to 3 the oscillator continues to operate while the sawtooth causes the current driver to vary the current flowing in the sweep unit. Thus the sweep unit is caused to sweep from the lowest frequency to its highest frequency of the particular segment of the frequency spectrum which has been selected. At this point the multivibrator switches, terminating the operation of the sweep oscillator with a negative blanking pulse. The RF output at this instant falls to 0, with the result that the beam drops from point 3 to point 4. The trailing edge of the sawtooth from the horizontal amplifier causes the beam to return from point 4 to point 1, thus forming a base line. The recurrent cycles repeat this process. Typical patterns obtained on the screen when the signal generator is used with various networks are shown in figure 1-7.

1-32. SWEEP OSCILLATOR.

1-33. The sweep oscillator and associated circuitry (figure 1-8) are combined to produce an RF output of at least 0.25 volt between the frequencies of 4.8 and 102 MC in four bands.

1-34. The sweep oscillator unit is a current-driven device which consists of electron tube V6 and a group of toroid inductors in a tuned radio-frequency circuit. (The core material is commonly made in ring form—toroidal core—or E stampings, so that a closed magnetic path may be obtained. Cores designed for use at these frequencies usually have an effective permeability that is quite high.) The frequency of the tuned circuit is varied by the amount of current and its rate of change through these toroid elements.

1-35. The sweep oscillator unit has a group of six terminals to supply operating voltages for the unit.

Terminals		Connections
1	=	Chassis ground
2	=	6.3 VAC at 0.4 amp
3	=	Regulated plate voltage for V6 that varies with AGC action (nominal 150 VDC)
4	=	+275 volt supply
5	=	Output of current driver V5
6	=	Blanking pulse input

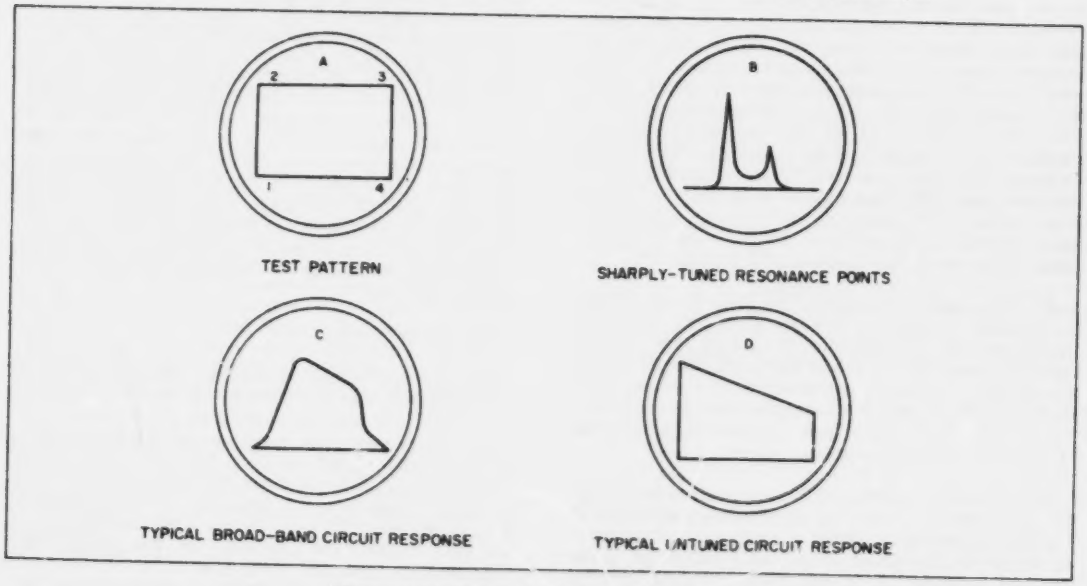

Figure 1-7. Typical Oscilloscope Patterns

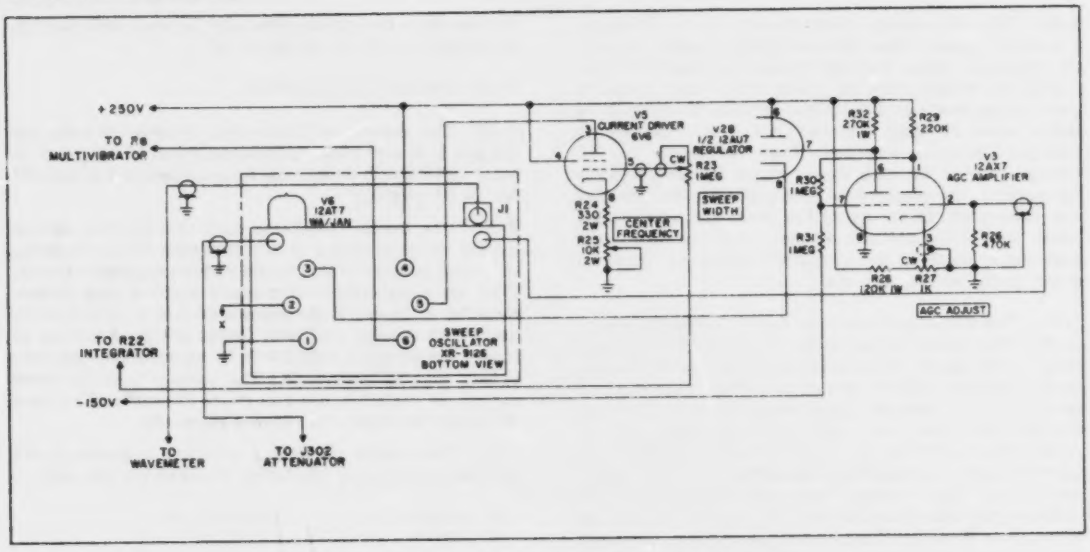

Figure 1-8. Sweep Oscillator, Schematic Diagram

1-36. There are three outputs from the sweep oscillator unit, one of which is the output jack J1, an RF output to the wavemeter. The second output provides a similar output to the attenuator. The third and remaining output connection furnishes a detected RF output to the input grid of the AGC amplifier V3A (figure 1-8).

1-37. The signal applied to the grid of V3A is of opposite phase to the output of the detector probe. The circuitry of the sweep oscillator detector duplicates that of the detector probe, with the exception of the polarity reversal of the detected signal. The AGC amplifier V3A is normally conducting. When a negative-going signal is applied to the grid (pin 2) of V3A, the conduction of the electron tube decreases, causing a rise in plate (pin 3) voltage. This voltage is coupled through resistor R30 to the grid (pin 7) of electron tube V3B. This causes an increase in current flow through V3B, which in turn causes a negative-going voltage to be applied to the grid (pin 7) of V2B. Thus, the current flow through V2B is reduced.

1-38. The voltage regulator V2B (figure 1-8) acts as a variable resistor in the B+ supply to the sweep oscillator, and the reduction in current flow will reduce the value of B+ that the sweep oscillator receives. Conversely, a positive-going signal will increase the current flow through V2B, thereby causing a smaller voltage drop to appear across V2B, and thus increasing the B+ applied to the sweep oscillator.

1-39. The action of the AGC circuit compensates for the nonlinearity occurring in the detected output of the sweep oscillator. When a nonlinear action tends to occur in the signal presented to the input of the vertical amplifier V101 and V102, a signal identical to that presented to the vertical amplifier, but 180 degrees out of phase, is applied to the AGC amplifier. Through the AGC function the B+ voltage supplied to the sweep oscillator is adjusted in such a manner as to prevent this change from taking place. The effect of the feedback voltage is controlled by resistor R27 (AGC ADJUST) and R28, which determine the bias for V3A.

1-40. The action of the sweep oscillator unit is a function of the current changes taking place in its system of toroid inductors. These current changes are provided by the output of the current driver V5. An output from the integrator V2A is applied to resistor R23 (SWEEP WIDTH), the center arm of which is connected to the grid (pin 5) of V5. The amplitude of the sawtooth voltage applied to the grid (pin 5) of V5 controls the width of the segment of the frequency spectrum which the sweep oscillator will cover. The cathode circuit, consisting of resistor R24 and R25 (CENTER FREQ), provides bias for the stage. The adjustment of resistor R25 determines the position of the center frequency of the frequencies to be displayed on the CRT. It does this by setting the starting reference level of current changes.

1-41. MULTIVIBRATOR.

1-42. The multivibrator (figure 1-9) is free running and furnishes two pulses—one for biasing the sweep oscillator, and one for driving the horizontal amplifier. The conventional multivibrator circuit employs a twin triode 12AU7 electron tube (V1) with circuit components as follows: plate load resistors R1 and R2, coupling capacitors C1 and C2, and grid resistors R3 and R4 with R5 constituting a variable portion of the grid resistor for V1A and V1B. The square-wave output taken from the plate (pin 1) of V1A becomes a clamped, negative-going square-wave by the action of

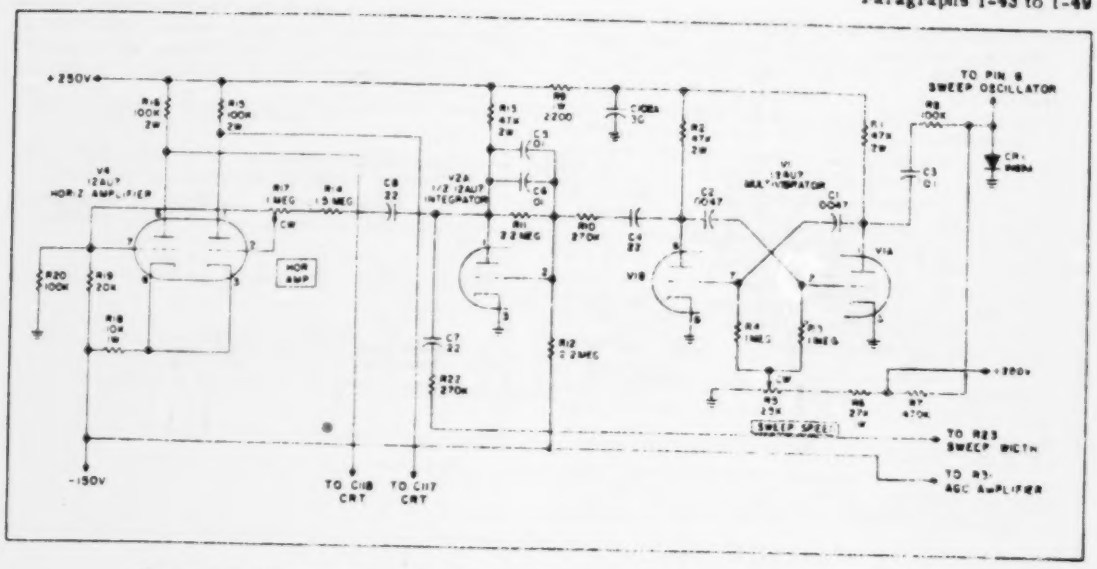

Figure 1-9. Multivibrator, Integrator and Horizontal Amplifier, Schematic Diagram

CR1, and is applied to the sweep oscillator as a blanking pulse. The pulse output appearing at the plate (pin 6) of V1B is applied to the grid (pin 2) of the integrator (V2A) and is used to drive the horizontal deflection circuit. The integrating action of the RC network (R11 and C5, C6) produces a triangle-shaped sawtooth voltage which is connected through capacitor C8, isolating resistor R14, and the HORIZ AMP control (R17) to grids 2 and 7 of V4. The conventional horizontal amplifier V4 amplifies the sawtooth voltage. The output from pins 1 and 6 of V4A and V4B are coupled through C117 and C118 to the horizontal deflection plates. The output of the integrator is also coupled through capacitor C7 and resistor R22 to the current driver (V5).

1-43. WAVEMETER.

1-44. The function of the wavemeter (figure 1-10) is to supply a frequency-determining pulse to the cathode-ray oscilloscope display at the frequency point for which the FREQUENCY dial and BANDSWITCH are set. An RF signal is fed from the oscillator through a coaxial cable to the wavemeter input resistor R406. The RF voltage appearing across resistor R406 is fed through isolating resistor R415 and blocking capacitor C406 to the wavemeter tuned circuit consisting of variable capacitor C407 and coils L401, L402, L403, or L404, whichever is connected by BANDSWITCH S401.

1-45. The frequency range of 5 to 100 MC is covered in four bands by means of selecting the proper coil with BANDSWITCH (S401) which shorts the other three unused coils to ground to avoid spurious resonance. Frequency is indicated on the FREQUENCY dial with four calibrated scales.

1-46. The resonant voltage wave appears across the tuned circuit and resistor R414, which is in parallel with it. The frequency of RF voltage fed from the oscillator passes through the resonant frequency of capacitor C407 and the coil in the circuit. This voltage is rectified by crystal CR401, and the rectified voltage is applied across resistor R401 to the grid of the V401A. Bias for this 6SL7WGT twin triode is furnished by cathode resistor R402, which is bypassed by capacitor C402. The voltage appearing across resistor R400 in the plate circuit of V401A, is applied to capacitor C403 and resistor R405, which differentiate this signal. Resistor R416 is used to supply additional fixed bias to shift the operating point of V401A so that the blanking-pulse generator will coincide with the actual frequency on the cathode-ray display. Tube V401B amplifies this voltage, which then appears across plate load resistor R403. The voltage is coupled through capacitor C404 to the grid of another 6SL7WGT tube (V402A) across grid resistor R408. Bias for V402A is furnished by cathode resistor R404. The amplified signal appears across plate load resistor R411 and is then coupled to the grid of V402B through capacitor C405 and resistor R409, which serves as a differentiating network. This network sharpens the signal still further. Bias for V402B is supplied by resistor R407 in conjunction with resistor R413; bypassing action is carried out by capacitor C401.

1-47. The pulse applied to the grid of V402B appears across plate resistor R412 considerably amplified and is then coupled through capacitor C400 to the MARKER WIDTH control (P410), the center arm of which is connected to the grid circuit (Pin 3) of the cathode-ray tube (V103).

1-48. ATTENUATOR.

1-49. The RF voltage generated by the oscillator is fed into the attenuator (figures 1-2 and 1-11) by a

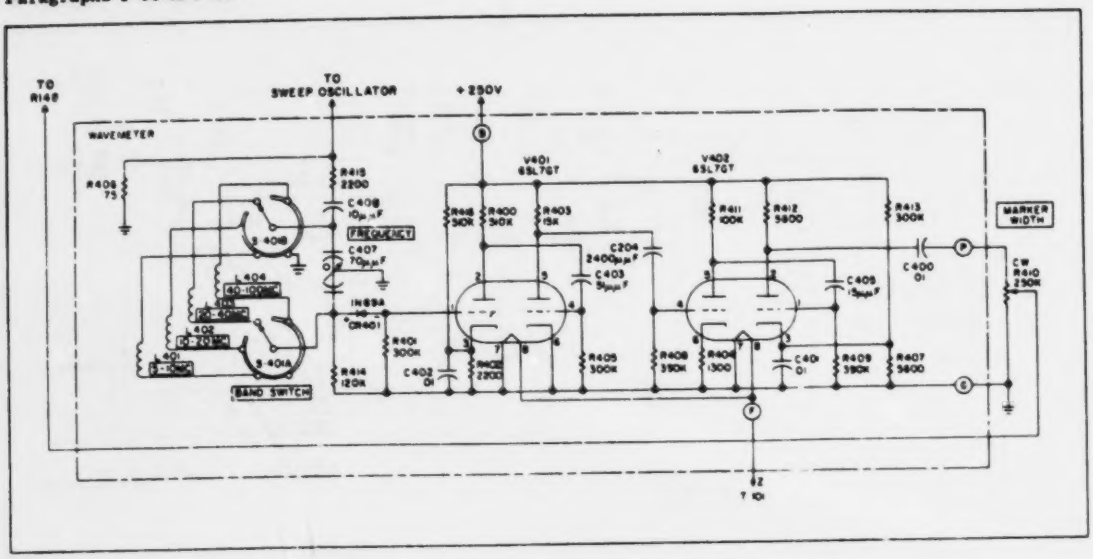

Figure 1-10. Wavemeter, Schematic Diagram

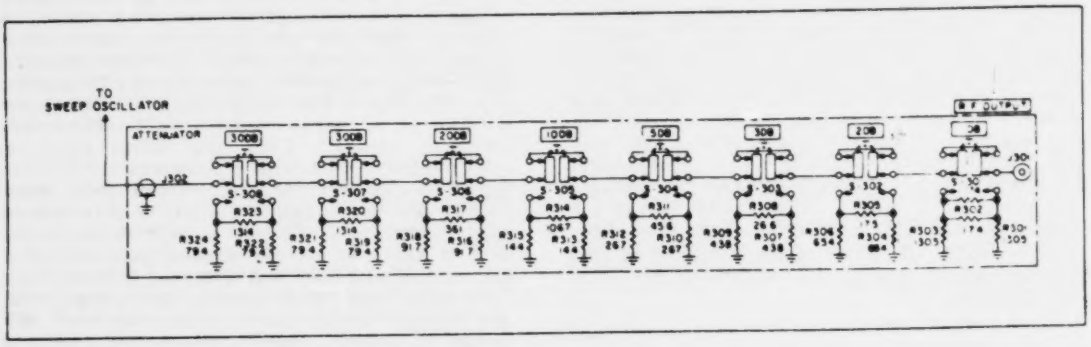

Figure 1-11. Attenuator, Schematic Diagram

coaxial plug which connects to the elbow jack (J302) at the side of the attenuator casting. Attenuation is accomplished by coupling the resistive pi networks across this line, since effective attenuation is additive. Attenuation is made available through eight pushbuttons for values of 1, 2, 3, 5, 10, 20, and two steps of 30 db, any combination of which may be used, providing a total of 101 db in steps of 1 db. The output from the attenuator is available at the R.F. OUTPUT receptacle (J301).

1-50. When the pushbutton switches S308 to S301 are in the out position, a complete circuit exists from the input through each of these switches to the R.F. OUTPUT receptacle, which provides zero attenuation. However, as each switch is pressed, the corresponding pi resistive network is inserted, producing the attenuation indicated. Switch S308 furnishes 30 db of attenuation in conjunction with resistors R324, R323, and R322. The second 30-db step consists of S307 and resistors R301, R320, and R319. S306, R318, R317 and R316 furnish 20 db of attenuation. The other attenuation values are furnished in a similar manner.

1-51. DETECTOR PROBE.

1-52. The function of the probe (figure 1-12) is the detection of an RF voltage and supplying it in such form to the vertical amplifier that it can be amplified and displayed on the cathode-ray oscilloscope. The probe incorporates an input blocking capacitor C201, through which the RF voltage is introduced to crystal CR201 for rectification. The input load resistor is R201 Resistor R202, in conjunction with capacitor

C202, forms a filter and bypass network for the rectified RF voltage and has a very short time constant. The output from the probe is available at the end of the coaxial cable terminated in plug P201.

1-53. VERTICAL AMPLIFIER.

1-54. The input to the cathode-ray oscilloscope is amplified by the vertical amplifier (figure 1-13), which consists of tubes V101 and V102 and their circuit components. The signal is fed through the

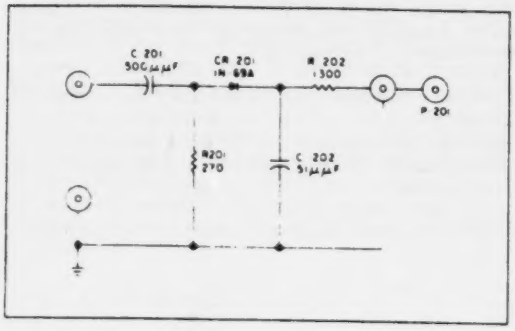

Figure 1-12. Detector Probe, Schematic Diagram

INPUT receptacle (J201) and appears across the VERT. AMP. control (R101). The center arm of this control is fed to pin 1 the grid of a 6SN7WGT twin triode voltage amplifier (V101A). Bias for this tube is furnished by cathode resistor R102. The amplified signal appears across plate load resistor R103 and is coupled through capacitor C101 to the grid pin 4 of this tube (V101B). R104 is the grid resistor for this triode section, while bias is furnished by cathode resistor R105. The amplified signal appears across plate load resistor R106, which is then coupled through capacitor C104 to the grid (pin 1) of V102A. Resistor R107 serves as a decoupling resistor between tubes V101 and V102, in conjunction with bypass capacitors C102A and C103. Additional filtering for the low-level amplifier V101 is also furnished by capacitor C102A.

1-55. Tube V102 is a push-pull stage furnishing a balanced signal to the cathode-ray oscilloscope. Coupling between triodes is accomplished in the cathode circuit; the grid of V102B is grounded while the input signal is fed into the grid of tube V102A across resistor R108. Resistors R111 and R110 are plate load resistors of V102A and V102B, respectively.

1-56. When the grid of V102A is driven in a positive direction, the cathode current increases, causing a voltage drop across the common cathode resistor (R109). This action raises the cathode potential with respect to ground. Since the grid of V102B is held at ground potential and its cathode has been driven

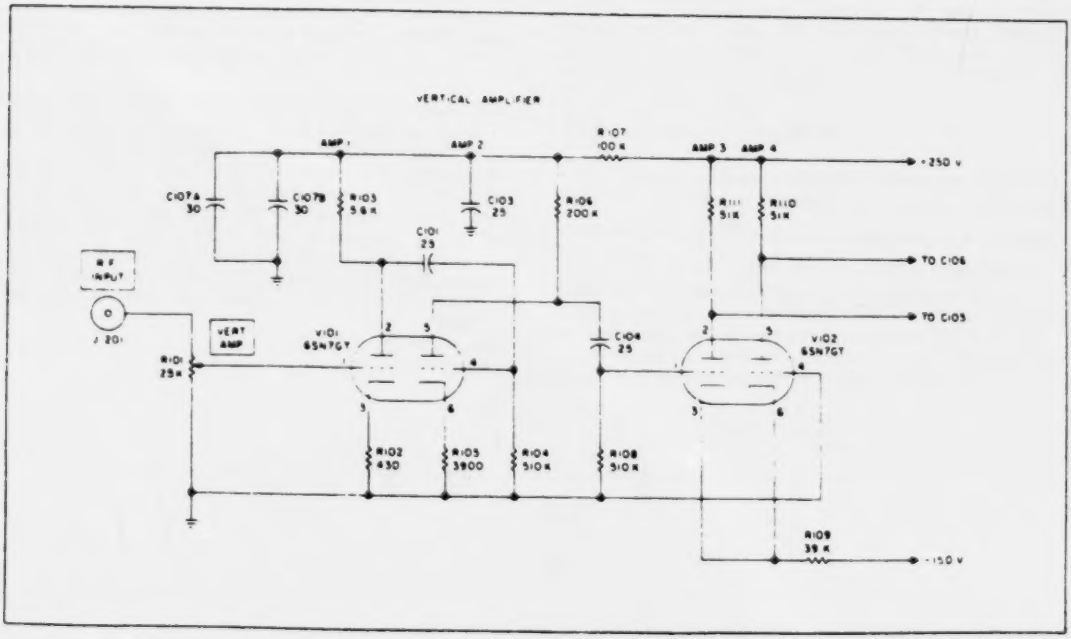

Figure 1-13. Vertical Amplifier, Schematic Diagram

positive, the equivalent effect is that of the grid being driven negative. Consequently a positive potential signal will appear in the plate circuit of V102B, while V102A will produce an equivalent negative signal at its plate, because its grid has been driven positive. Audio output from this amplifier, balanced with respect to ground, is taken from the plates of V102A and V102B and is fed through capacitors C105 and C106 to the vertical deflection plates of the cathode-ray tube (V103).

1-57. CATHODE-RAY OSCILLOSCOPE.

1-58. The cathode-ray tube oscilloscope (figure 1-14) (V103) displays the signal fed into it from the vertical amplifier (V102). The control grid (pin 3) of the cathode-ray tube (V103) is connected to the wavemeter output from which is obtained the blanking pulse for frequency indication on the display. The main power supply furnishes 1300 VDC negative, 150 VDC positive, 150 VDC negative and 6.3 VAC for operation of the 3BP1A cathode-ray tube (V103). The negative high voltage is fed to one end of the INTENSITY control (R141). The center arm of potentiometer (R141) is connected to the grid (pin 3) of V103 through resistor R138. This control varies the bias on the tube and hence controls the intensity of the display on the screen of the tube. The other end of R141 is connected to the cathode (pin 2) of V103, with resistors R142, R143, R146, and R147 acting as a voltage divider to ground. Focusing of the cathode-ray beam is accomplished by the FOCUS control (R143). The anode (pin 9) of V103 is connected to ground, thereby making it approximately 1300 volts positive with respect to the cathode.

1-59. The blanking pulse output from the wavemeter (paragraph 1-44) is fed through resistor R148 and blocking capacitor C120 to the grid (pin 3) of V103. When the negative pulse appears in this circuit, the

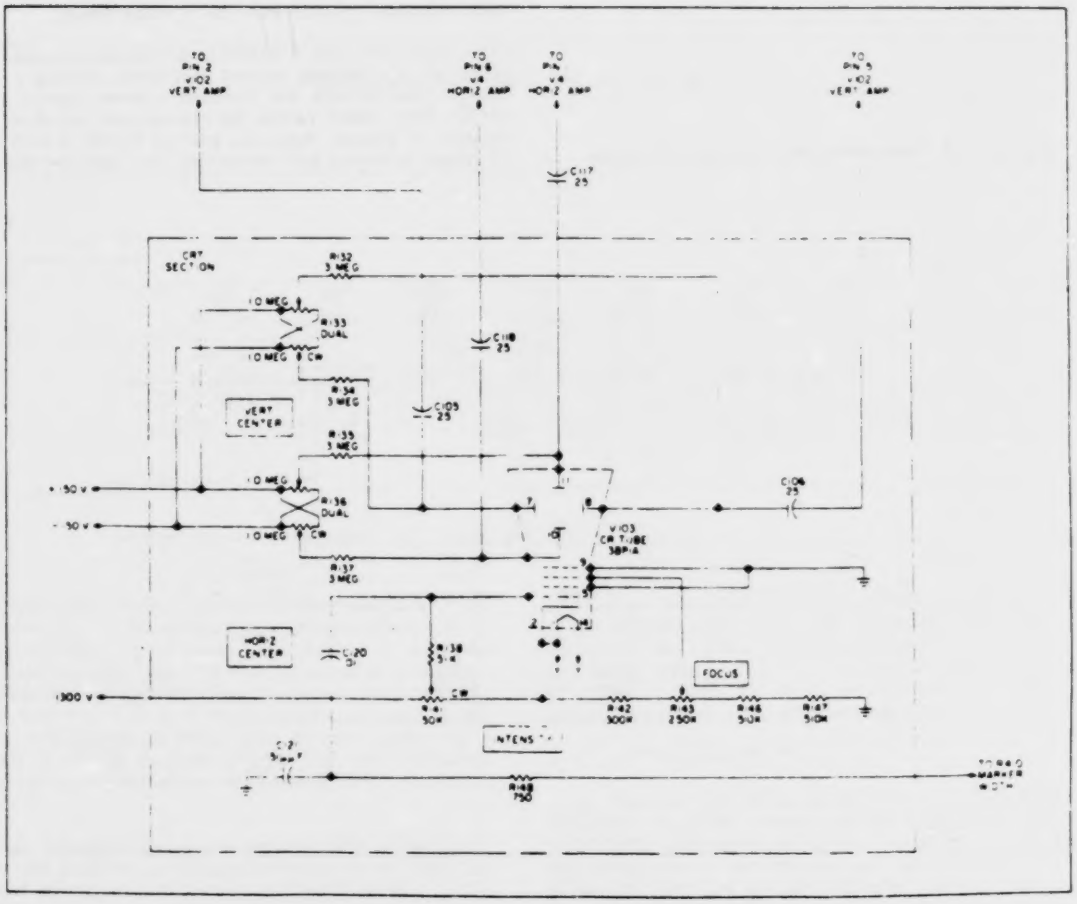

Figure 1-14. Cathode-Ray Oscilloscope, Schematic Diagram

grid is driven negatively to cut-off, which results in a complete blocking of the electron beam in V103; consequently, a dark spot appears on the pattern at the instant when this negative pulse is applied.

1-60. Electrodes 7 and 8 of V103 are the vertical plates controlling the displacement of the beam in the vertical plane. Input from the vertical amplifier is fed through blocking capacitors C105 and C106 to these plates. Resistors R132 and R134 maintain a high impedance from the deflecting plates to ground. The positioning voltages from the VERT CENTER controls (R133A and R133B) are fed to the plates in opposite polarity so that, as one is driven positive, the other is driven a corresponding amount negative.

1-61. A similar positioning arrangement is furnished in the horizontal deflection circuit consisting of HORIZ CENTER controls (R136A and R136B) and resistors R135 and R137. The sweep voltage from V4 is supplied to the plates through blocking capacitors C117 and C118.

1-62. POWER SUPPLY.

1-63. Power for all circuits is furnished by the power supply (figure 1-15), which consists of transformer T101 and rectifier tubes V105, V106, and V104 and their filter and regulator networks. Primary input voltage is 115 volts ac ±10 percent at any frequency between 50 and 1600 cps. The primary circuit is fused by F101 and controlled by switch S101. Pilot lamp DS101 indicates when power is on.

1-64. The power transformer (T101) furnishes 250 VAC between terminals 5 and 6 and between 6 and 7. This voltage is applied to the plates of a 6X5WGT full-wave rectifier tube (V105) and is then filtered by inductor L101 and capacitors C107B, C111A, and C111B, providing 275 VDC at the filter output. Resistors R127 and R128 form a voltage divider to furnish 150 volts positive for the deflection plates of the cathode-ray tube (V103). Capacitor C112 serves as a bypass filter to ground.

1-65. Terminal 7 of the power transformer (T101) also furnishes 275 VAC to the cathode of another 6X5WGT rectifier tube (V106) in order to provide a negative voltage for bias purposes. The two plates of this tube are tied together and are connected to the filter network consisting of resistor R123 and shunt capacitors C110A and C110B. R130 is the dropping resistor for the OD3/VR150 voltage regulator tube (V107), and R131 is the dropping resistor for another regulator tube (V108). Load resistor R129 and bypass capacitor C113 shunt tube V107. The output voltage of this tube, at a value of minus 150 volts, is fed to the deflection plates of the cathode-ray tube (V103) and also furnishes bias to the vertical amplifier output tube (V102). The negative 150 volts output from the V108 is fed to the integrator (V2A), and AGC amplifier (V3B), and to horizontal output (V4).

1-66. The power transformer (T101) develops 1100 VAC between its terminals 6 and 8. The end of this secondary winding is connected to a filament winding (between terminals 8 and 9). The filament of the high-voltage half-wave 1B3GT rectifier tube (V104) is connected to these terminals and consequently to the high voltage. The plate of rectifier V104 supplies a negative DC voltage of approximately 1300 volts across the filter network consisting of capacitors C115 and C116 and resistor R140. This high voltage output is then supplied to the voltage divider of the cathode-ray oscilloscope.

1-67. The power transformer (T101) also furnishes 6.3 VAC from terminals 10 and 11 to the heater of the sweep oscillator tube (V6). Terminals 12 and 13 supply 6.3 VAC to the heater of the cathode-ray tube (V103) and terminals 3 and 4 furnish 6.3 VAC to the heater of all other tubes in the unit.

1-68. SCHEMATIC DIAGRAM.

1-69. Signal Generator TS-452D/U over-all schematic diagram is shown in Figure 1-16, and TS-452E/U over-all schematic diagram is shown in Figure 1-17. Each inter-component circuit, and all connections and terminals between each component is shown. Dotted lines completely enclose each unit. This diagram is used in the succeeding sections of this book as reference material, and is necessary for the servicing of the equipment.

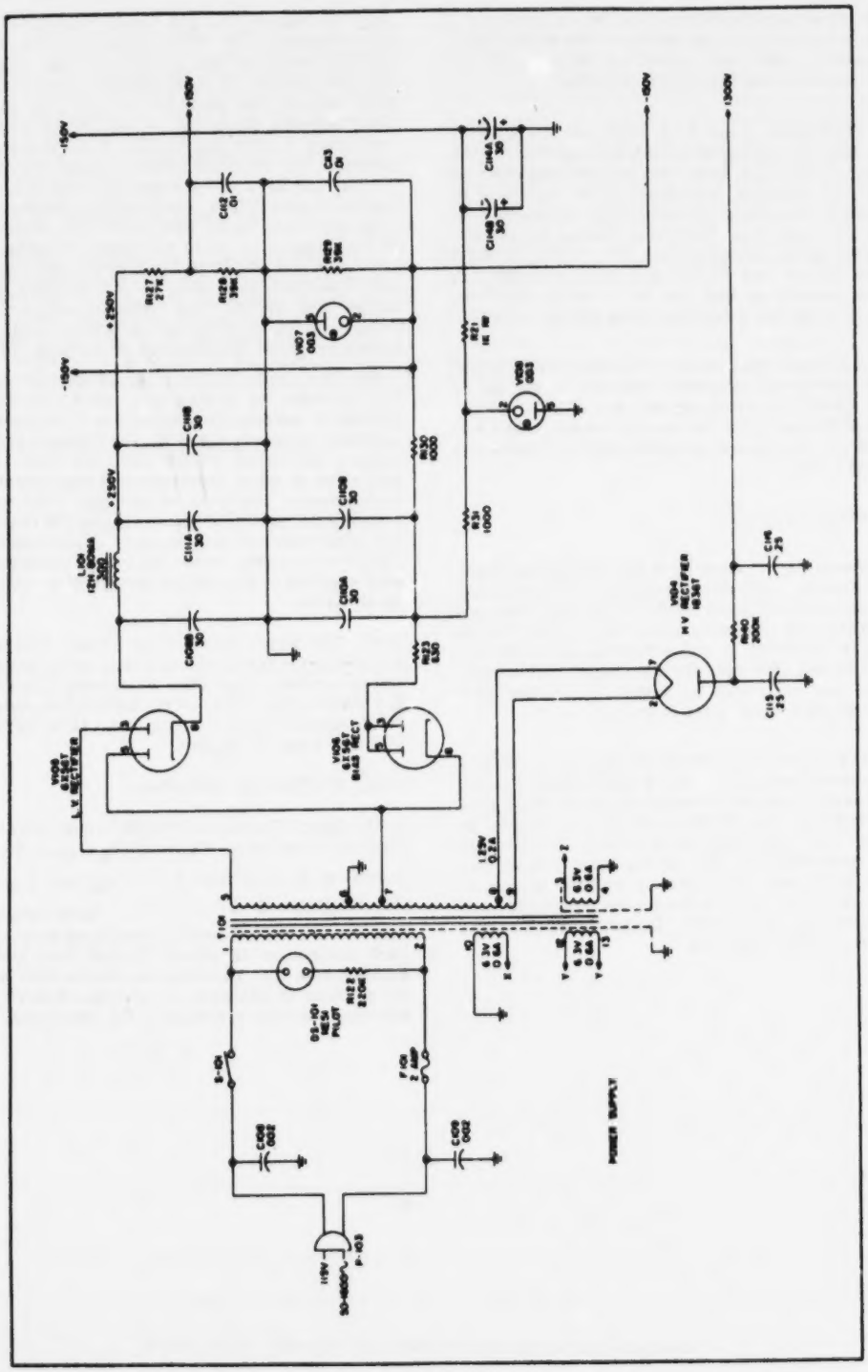

Figure 1-15. Power Supply, Schematic Diagram

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. GENERAL.

2-2. This section lists the standard test equipment and special tools required for maintenance of Signal Generator TS-452D/U.

2-3. TEST EQUIPMENT.

2-4. A list of test equipment required for maintenance of the signal generator appears in Table III.

2-5. SPECIAL TOOLS.

2-6. No special tools are required for the maintenance of this signal generator.

Table III. Standard Test Equipment

Nomenclature	Manufacturer's Designation	Alternate	Use
Multimeter	AN/USM-223	TS-352 PSM-4 PSM-6	AC, DC, and resistance measurements
Multimeter	ME-26D/U		RF voltage measurement
Signal Generator	AN/USM-44	URM-26	Calibrating wavemeter
Counter, Electronic Digital Readout	AN/USM-207A	USM-26	Calibrating wavemeter

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. GENERAL.

3-2. This section contains unpacking instructions and detailed procedures covering the preparation for use, shipment, or storage of Signal Generator TS-452D/U.

3-3. The signal generator and its accessories are housed for shipment in a rectangular, splash-proof case painted olive drab (figure 3-1). The case is a riveted construction of metal and balsa wood laminations. On the inside of its cover all the generator accessories attach. Four brackets at the corners of one long side of the case serve as feet. Two carrying handles, and two coil-spring cover catches are located on each short side and two catches on each long side of the case near the case opening. Four sheet-metal angle pieces, mounted on eight medium-hard rubber shock mounts at the corners of the case, serve as guides for insertion and removal of the generator. Four rubber blocks attached to the farthest inside wall of the case act as shock mounts at the rear of the generator.

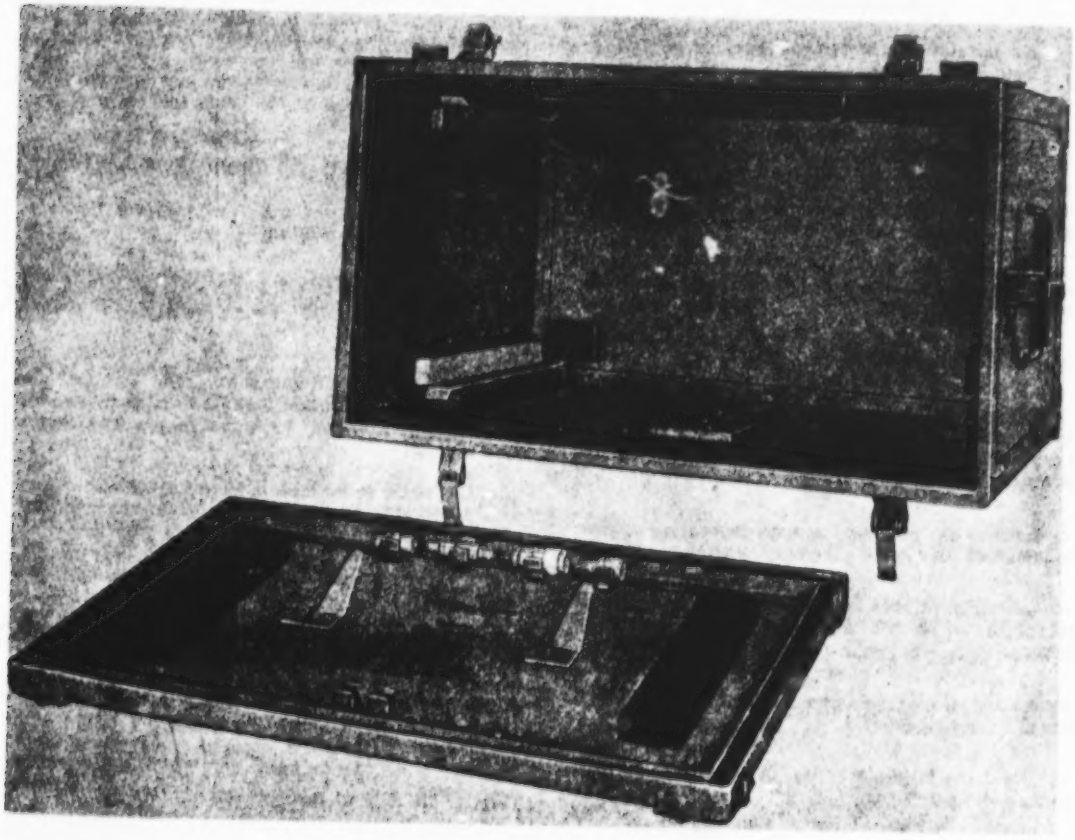

Figure 3-1. Transit Case (CY-1618/U)

3-4. Around the inside edge of the case cover, where there is pressure against the case, there is a rubber gasket. Two rectangular rubber blocks on the upper inside surface of the cover act as shock mounts for the front panel of the generator. The two removable cables are wound around two sheet-metal brackets attached to the same surface as the shock mounts. Six spring clips are distributed on two walls of the cover. The two most closely spaced on the wall having four clips are used to hold the probe attached to the traveling detector cable; the remaining four each hold one of the three adapters and terminating resistor.

3-5. UNCRATING.

3-6. When equipment is received, select a location where it can be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment.

CAUTION

Be careful in uncrating, unpacking, and handling the equipment; it is easily damaged. If it should become damaged or exposed, a complete overhaul might be required or the equipment might be rendered useless.

3-7. To uncrate the signal generator unit in its transit case, proceed as follows:

a. Place the packing case as near the operating position as convenient.

b. Cut and fold back the steel straps.

c. Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top. Such action might damage the equipment.

d. Remove any excelsior or corrugated paper covering the inner corrugated fiberboard carton.

e. Carefully remove the equipment from the carton and place it on the workbench or near its final location.

f. Inspect the equipment for possible damage incurred during shipment.

g. Check the contents of the packing case against the master packing slip.

Note

Save the original packing case and containers. They can be used again when the equipment is repacked for storage, or shipment.

3-8. EQUIPMENT SUPPLIED.

3-9. The equipment listed in Table IV should be supplied within the transit case of Signal Generator TS-452D/U.

3-10. To remove Signal Generator TS-452D/U from its transit case, grasp the handles of the signal generator and slowly lift the signal generator until it clears the transit case. The accessories can be removed from beneath the transit case cover whenever these accessories are required.

3-11. CONNECTIONS.

3-12. Signal Generator TS-452D/U is ready to function under different methods of operation once it has been removed from the transit case. A power cable is internally connected into the signal generator unit. A-C power can then be supplied by inserting the male plug at the other end of the cable into the available 115-volt, 60-cps source.

3-13. DISASSEMBLY AND PACKING.

3-14. To prepare the unit for transportation and storage, proceed as follows:

a. Disconnect the power cable from the A-C source and wrap cable around the handles of the signal generator unit.

b. Place the signal generator unit back into its transit case, and replace the transit case cover with all accessories clipped or stored in place under the cover.

c. The exact procedure in repacking for shipment or limited storage depends upon material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 3-7 and reverse the instructions given in that paragraph for recrating.

d. Whenever practicable, place a denydrating agent such as silica gel inside the packing boxes. Protect the inner boxes with a waterproof barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected boxes in a snug-fitting paperboard container and place in a wooden crate conforming to standard packaging procedures.

Table IV. Equipment Supplied

Quantity of Each	Name of Unit	Air Force Designation	Over-all Dimensions (in.)	Weight (lbs.)
1	Signal Generator (less accessories)	TS-452D/U	19 x 16 x 9-3/4	50.0
1	Detector (probe and cable)	DT-149/U	1-1/4 dia x 60 (including cable)	0.45
1	Output Cable	CG-426D/U	9/16 dia x 60	0.25
1	Adapter	UG-83A/U	3/4 dia x 1-5/8	0.1
1	Adapter	UG-255/U	5/8 dia x 1-3/8	0.1
1	Adapter	UG-273/U	3/4 dia x 1-3/8	0.1
1	Terminating Resistor	UG-1100/U	1 dia x 2-1/2	0.2
1	Transit Case	CY-1618/U	23 x 19 x 13-7/8	18.0
1	Calibrated Scale	MX-1638/U	3-3/16 dia	

SECTION IV

OPERATION INSTRUCTIONS

4-1. GENERAL.

4-2. This section lists the procedures for operating Signal Generator TS-452D/U.

4-3. OPERATING AND ADJUSTMENT CONTROLS.

4-4. Table V lists the front, top, and rear panel controls, indicators, and receptacles and their functions (figures 4-1, 4-2, and 4-3).

4-5. OPERATING THE SIGNAL GENERATOR.

4-6. The rest of this section consists of directions for preparing and operating the signal generator.

4-7. PREPARATION FOR USE.

4-8. Prepare the signal generator for use as follows:

a. Connect ground to signal generator.

b. Flip POWER switch to OFF position.

c. Insert AC plug into receptacle (103 to 127 volts AC, 50 to 1600 cycles).

d. Remove accessories as needed from transit case cover.

e. Release all ATTENUATOR pushbuttons.

f. Turn SWEEP OSCILLATOR BANDSWITCH to $\frac{30}{100\ MC}$ position (Band D).

g. Turn WAVEMETER BANDSWITCH to $\frac{40}{100\ MC}$ position (Band D).

h. Connect signal generator as shown in figure 4-4.

i. Flip POWER switch to ON position.

j. Allow 1 minute for signal generator to warm up. Turn VERT. AMP. control fully clockwise.

k. Adjust INTENSITY, FOCUS, VERT CENTER, and HORIZ CENTER controls for the desired brilliance, clarity, and centering of display on cathode-ray tube. (Controls are located under the small door, on top of the signal generator.)

l. Turn SWEEP SPEED, SWEEP WIDTH, CENTER FREQUENCY, and MARKER WIDTH controls to approximately mid-position.

m. Adjust HOR. AMP. and VERT. AMP. controls for rectangular pattern on cathode-ray tube.

n. Turn AGC ADJUST control (rear of unit) so that the top line of the display is linear within two adjacent horizontal lines on the calibrated screen.

o. Turn WAVEMETER FREQUENCY dial to 65 on band D of dial.

p. Turn CENT. FREQ. control to place 65 MC marker to approximately the center of the calibrated scale.

q. Turn WAVEMETER FREQUENCY dial to 100 on band D of dial. If marker disappears, adjust SWEEP WIDTH control in a counterclockwise direction until marker appears on display. If marker does not appear, repeat step n.

r. Adjust HOR. AMP. until 100 MC marker coincides with right vertical edge of the display.

s. Disconnect leads connected in step h.

4-9. RECEIVER ALIGNMENT.

4-10. Perform receiver alignment with the Signal Generator TS-452D/U as follows:

a. TS-452D/U is ready for receiver alignment. Connect signal generator as shown in figure 4-5.

b. Additional impedance-matching network may be necessary for input impedance other than the terminating adapter impedance of 75 ohms nominal. Connect intermediate frequency (IF) amplifier input to termination adapters through a connector or short solid wire (1 inch or less).

c. Use short solid wire leads between detector probe chuck and grid circuit of the tube following the IF stages to be checked.

d. Adjust IF bandpass curve viewed on cathode-ray tube to a convenient size, using horizontal and vertical controls.

e. To check bandwidth at half power, press in ATTENUATOR 3-db pushbutton. Note that pattern decreases in height. With the VERT CENTER control, position the top part of the viewed pattern to the exact height of one of the calibrated screen lines. Release the ATTENUATOR 3 db. Note increase in pattern height. Adjust FREQUENCY TUNING dial so that left-hand edge of the frequency marker coincides with one point where the IF curve and screen line noted above intersect. Read and record frequency. Check the second point on the other side of the curve. The difference between the two recorded frequencies represents the bandwidth at half power.

f. Where the viewed pattern is symmetrical, the mid-frequency can be checked with the frequency marker. Where the pattern is nonsymmetrical, the mid-frequency is determined by the sum of the lowest frequency plus one half of the recorded difference frequency noted in step e.

g. The IF stages can be adjusted for the desired center frequency, bandwidth, or other necessary configuration with continuous monitoring of the pattern during adjustment.

Table V. Operating Controls, Indicators and Receptacles (Sheet 1 of 2)

Designation	Type	Function
Front Panel		
INPUT	Receptacle	Connection of the input signal, generally obtained from the probe, to the vertical amplifier circuit of the signal generator.
R.F. OUTPUT	Receptacle	Appearance of RF output from sweep oscillator at this receptacle.
VERT. AMP.	Control	Control of amplitude of signal appearing on face of cathode-ray indicator tube.
HOR. AMP.	Control	Control of length of horizontal time base of display on face of cathode-ray indicator tube.
MARKER WIDTH	Control	Control of width of marker signal on display shown on face of cathode-ray indicator tube.
SWEEP SPEED	Control	Control of rate of sweep of the horizontal time base of display shown on face of cathode-ray indicator tube.
SWEEP WIDTH	Control	Control of the frequency range of sweep oscillator within the limits of the band selected.
CENT. FREQ.	Control	Shifting of center frequency of sweep oscillator output to vary the center of the frequency display shown on cathode-ray indicator tube.
ATTENUATOR	Pushbutton Switch	Control of level at the R. F. OUTPUT receptacle. (There are eight switches for values of 1, 2, 3, 5, 10, and 20 and two steps of 30 db attenuation. Any combination of them can be used, providing a total of 101 db attenuation in steps of 1 db.)
WAVEMETER BANDSWITCH	Switch	Selection of proper band for the frequency to be covered by the wavemeter circuit in the signal generator unit.
WAVEMETER FREQUENCY	Switch	Indication of exact frequency within the frequency band selected.
WAVEMETER TUNING	Dial	Determining of exact frequency desired within the frequency band selected.
SWEEP OSCILLATOR BANDSWITCH	Switch	Selection of sweep frequency band.
POWER ON	Toggle switch	Control of AC power input to signal generator.

Table V. Operating Controls, Indicators and Receptacles (Sheet 2 of 2)

Designation	Type	Function
Front Panel (Cont.)		
POWER	Indicator	Indication by illumination of lamp that AC power is being supplied to signal generator.
(Cathode-ray tube)	Indicator	Display of signal applied to it from the vertical amplifier circuit in the signal generator.
Top Panel		
HORIZ CENTER	Control	Control of horizontal position of the display on the cathode-ray indicator tube.
VERT CENTER	Control	Control of vertical position of the display on the cathode-ray indicator tube.
FOCUS	Control	Control of sharpness or focus of the display shown on the cathode-ray indicator tube.
INTENSITY	Control	Control of intensity of the display shown on the cathode-ray indicator tube.
Rear Panel		
AGC	Control	Control of linearity of the display shown on the cathode-ray tube. (Refer to paragraph 4-7, step n.)

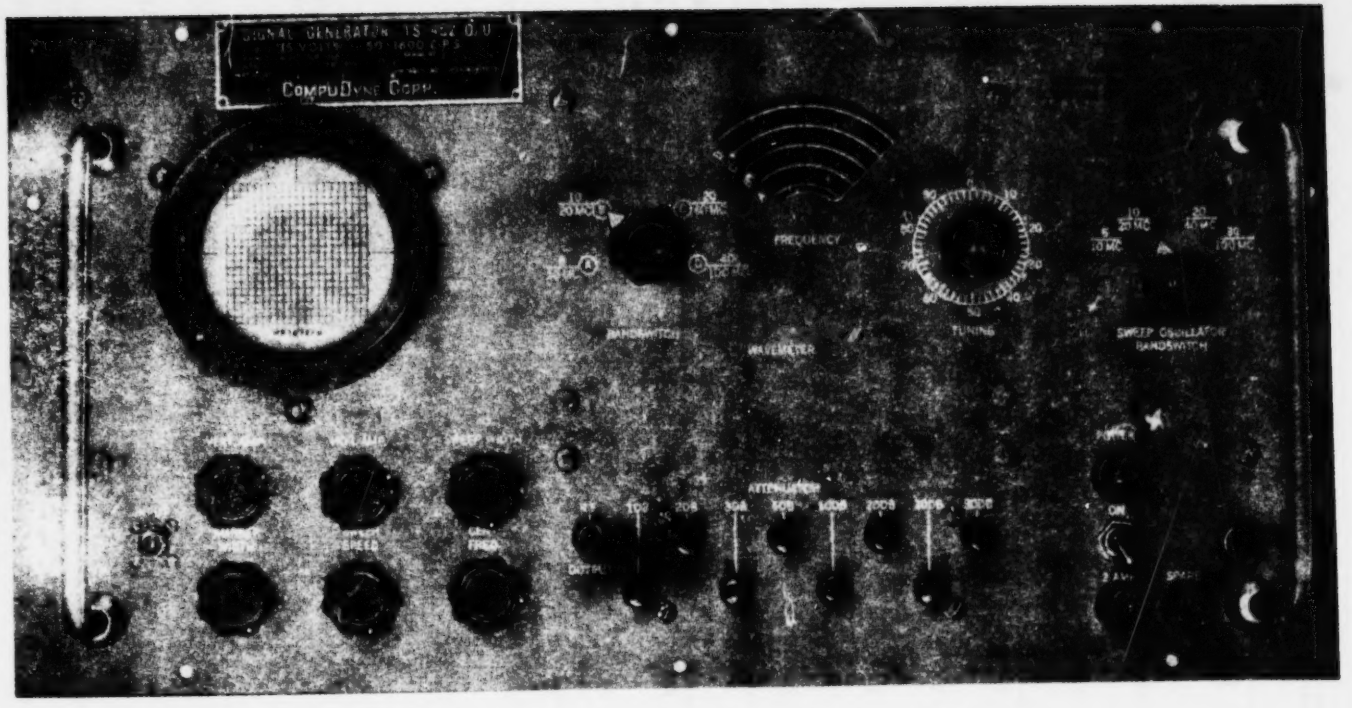

Figure 4-1. Signal Generator TS-452D/U, Front Panel View

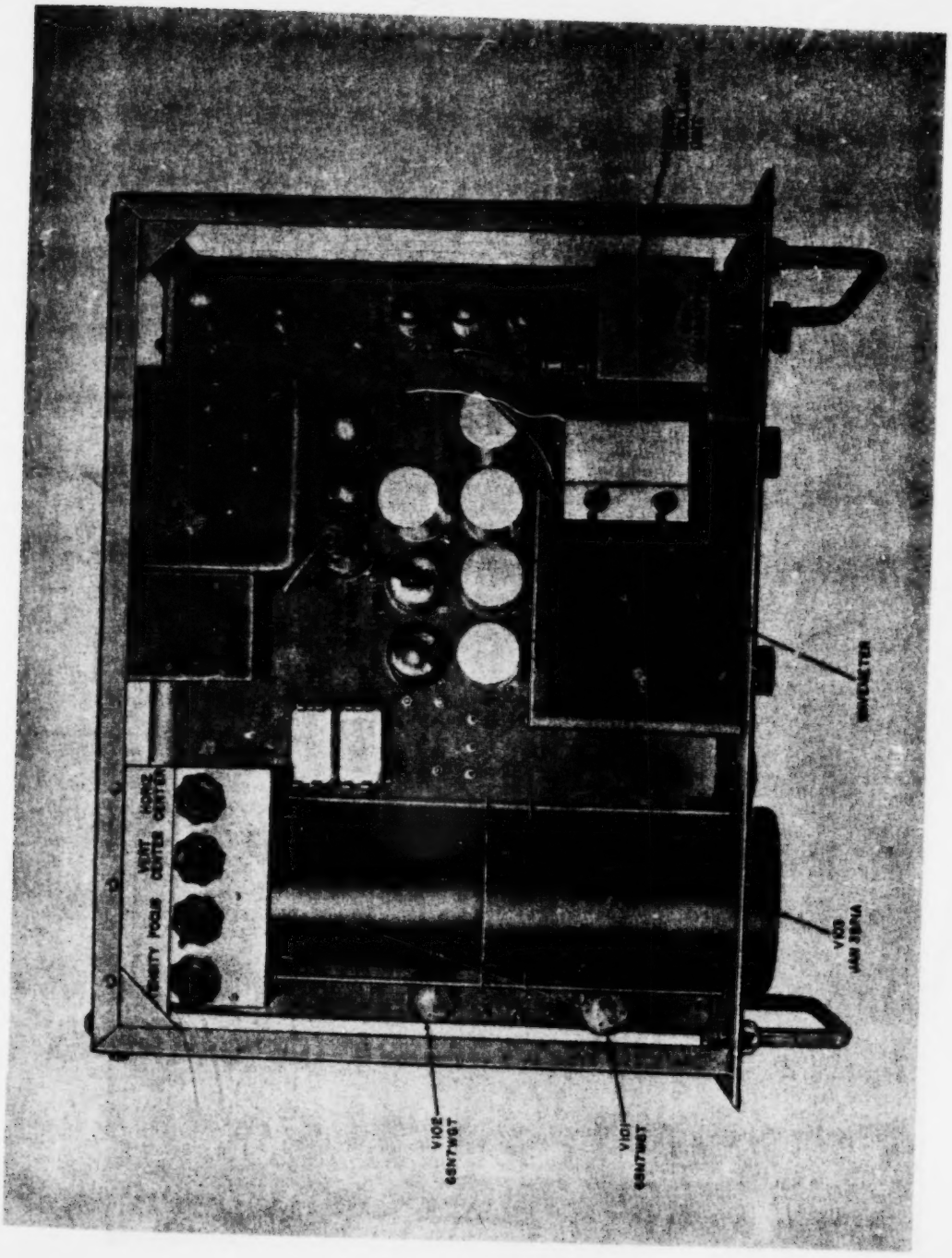

Figure 4-2. Signal Generator TS-452D/U, Top View with Protective Case Removed

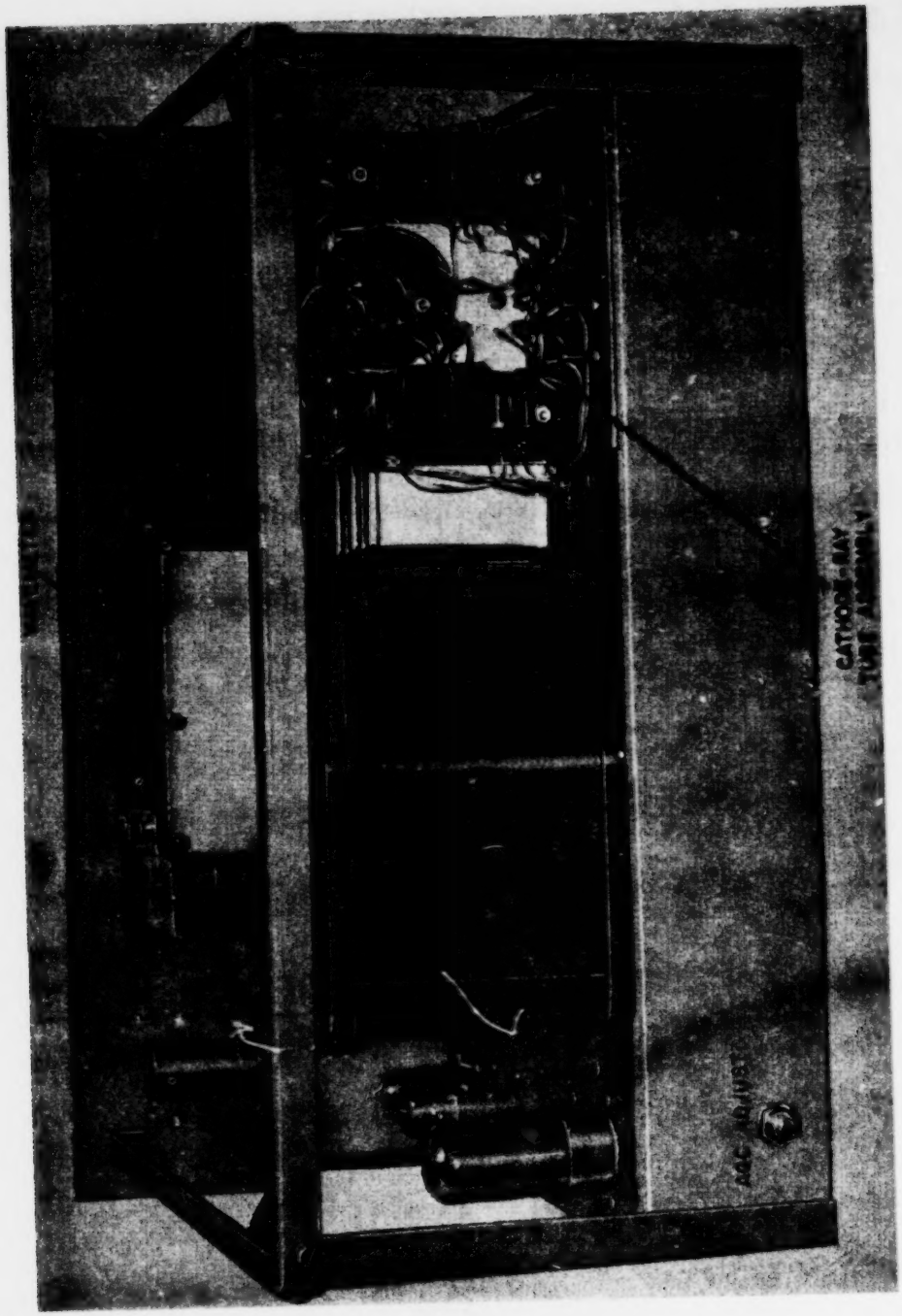

Figure 4-3. Signal Generator TS-453D/U, Rear View with Protective Case Removed

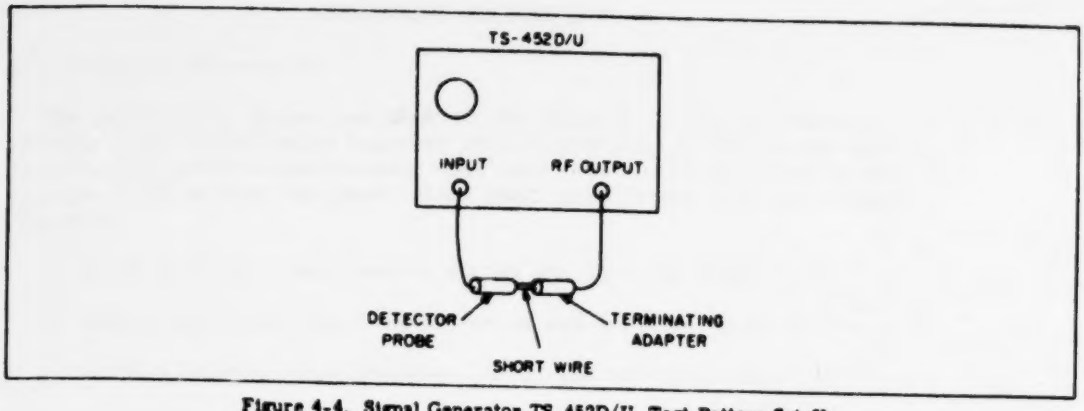

Figure 4-4. Signal Generator TS-452D/U, Test Pattern Set-Up

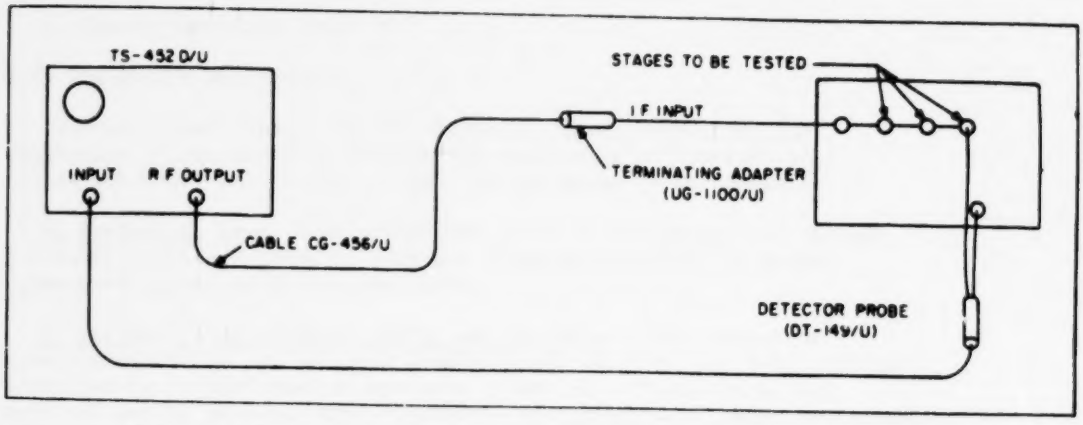

Figure 4-5. Signal Generator TS-452D/U, Typical Connection for Circuit Evaluation

SECTION V

MAINTENANCE INSTRUCTIONS

5-1. Scope of Maintenance

The maintenance duties assigned to the operator of Signal Generator TS-452D/U are listed below together with a reference to the paragraphs covering the specific maintenance function. The duties assigned do not require tools or test equipment other than those issued with the signal generator.

a. Daily preventive maintenance checks and services (para 5-4).

b. Weekly preventive maintenance checks and services (para 5-5).

c. Monthly preventive maintenance checks and services (para 5-6).

d. Cleaning (para 5-7).

e. Touchup painting (para 5-8).

5-2. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 5-4 through 5-8 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (para 5-4, 5-5, and 5-6) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the References column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions listed, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

5-3. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of Signal Generator TS-452D/U are required daily, weekly, and monthly. Paragraphs 5-4, 5-5, and 5-6 specify the items to be checked and serviced. In addition to the routine daily, weekly, and monthly checks and services, the equipment should be rechecked and serviced immediately before going on a mission and as soon after completion of the mission as possible.

5-4. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete (appendix III).	
2	Cleanliness	Clean the equipment according to paragraph 5-7.	
3	Controls	While making the operating checks (item 5 below), observe that the mechanical action of each control is smooth and free of external or internal binding.	
4	Lamp	While making the operating checks, observe that the POWER indicator is lighted.	
5	Operation	Operate the equipment according to Table VI	

5-5. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Exterior items	Hand-check for loose handles, door hinge, door fastener, and front panel screws. Tighten as necessary.	
2	Cables	See that the cables are free of breaks, cuts, kinks, deterioration, strain, and fraying. Replace as necessary (appx III).	
3	Exterior surfaces	Inspect for rust, fungus, and corrosion. Remove rust and corrosion, and spot-paint bare spots according to paragraph 5-8.	Para 5-8.

5-6. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications	Check DA Pam 310-4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	DA Pam 310-4.
3	Gaskets	Check gaskets for moisture, oil saturation, and brittle, broken, cracked, loose, pinched, or missing sections.	
4	Fuses	Check for proper fuses. The fuses should be of the indicated value and located as follows: a. Fuse in use is on front panel of signal generator: 2 amp, 250 volts. b. Spare fuse is on front panel of signal generator: 2 amp, 250 volts.	

5-6. Monthly Preventive Maintenance Checks and Services Chart (cont)

Sequence No.	Item	Procedure	References
5	Hardware	See that all bolts, nuts, and washers are present and properly tightened.	
6	Pluckout items	Inspect clamps, connectors, adapters, rf coils, tube shields, and lamps for proper seating. Check for wrong, bent, or broken parts.	
7	Connections	Check to be sure that jacks, connectors, and adapters fit snugly and make good contact.	
8	Cathode-ray tube	Inspect for burned screen spots.	
9	Spare parts	Check all spare parts for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions. Check Appendix III for list of spare parts.	

5-7. Cleaning

Inspect the exterior of the signal generator. The exterior surfaces should be free from dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a clean soft cloth.

Warning: Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with Cleaning Compound (FSN 7930-395-9542).

c. Remove dust or dirt from the plugs and jacks with a brush.

Caution: Do not press on the crt face (glass) or FREQUENCY dial face when cleaning because these parts may become damaged.

d. Clean the front panel, the crt face, and the control knobs; use a soft clean cloth. If necessary, use water and mild soap.

5-8. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TM 9-213.

SECTION VI

TROUBLESHOOTING

6-1. GENERAL.

6-2. The troubleshooting and repair work that can be performed at the organizational maintenance level is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, troubleshooting is based on the performance of the equipment and the use of senses in determining such troubles as defective electron tubes and fuses, loose connections, and so on. The paragraphs which follow in this section help in determining which component, chassis, subchassis, or section of the equipment is at fault in that component which leads to the defective stage or item, such as a tube or fuse. Refer to Table III for required test equipment and to figures 4-2 and 6-1 for location of components.

6-3. VISUAL INSPECTION.

6-4. The purpose of visual inspection is to locate any trouble that can be seen with the eye. With this inspection alone the repairman can frequently discover the trouble or determine the stage in which the trouble exists. This inspection is valuable because additional damage to the equipment which might occur through improper servicing methods can be avoided and future failures can be forestalled.

6-5. OPERATIONAL TEST.

6-6. The operation of the equipment is important because it frequently indicates the general location of trouble (Table VI). In many instances the information gained will determine the exact nature of the fault. In order to utilize this information fully, the troubleshooter must interpret all symptoms in relation to each other.

6-7. ATTENUATOR RESISTANCES.

6-8. The attenuator resistances are listed in Table VII for each switch position. Table VII shall be used when specific trouble is in the attenuator.

6-9. TROUBLESHOOTING TABLE.

6-10. The troubleshooting table (Table VIII) lists troubles commonly encountered in the signal generator, their probable cause, and remedies.

6-11. VOLTAGE AND RESISTANCE DATA.

6-12. Table IX lists the voltage and resistances to ground from tube and plug-in capacitor socket terminals. For the conditions specified all measurements made on the equipment should agree with those in the table within ± 10 per cent.

6-13. VOLTAGE AND RESISTANCE MEASUREMENT CONDITIONS.

6-14. Prepare the signal generator for voltage and resistance checks as follows:

a. Input voltage to the equipment shall be 115 volts 60 cycles AC.

b. All ATTENUATOR switches must be in out position.

c. Cathode-ray oscilloscope variable controls must be set at mean value.

d. All variable resistor controls on front panel must be turned fully clockwise.

e. The AGC control (R27) shall be set for normal operation.

f. Voltage and resistance measurements are to be taken with all electron tubes in their sockets.

g. DC volts shall be measured with 20,000 ohms-per-volt voltmeter.

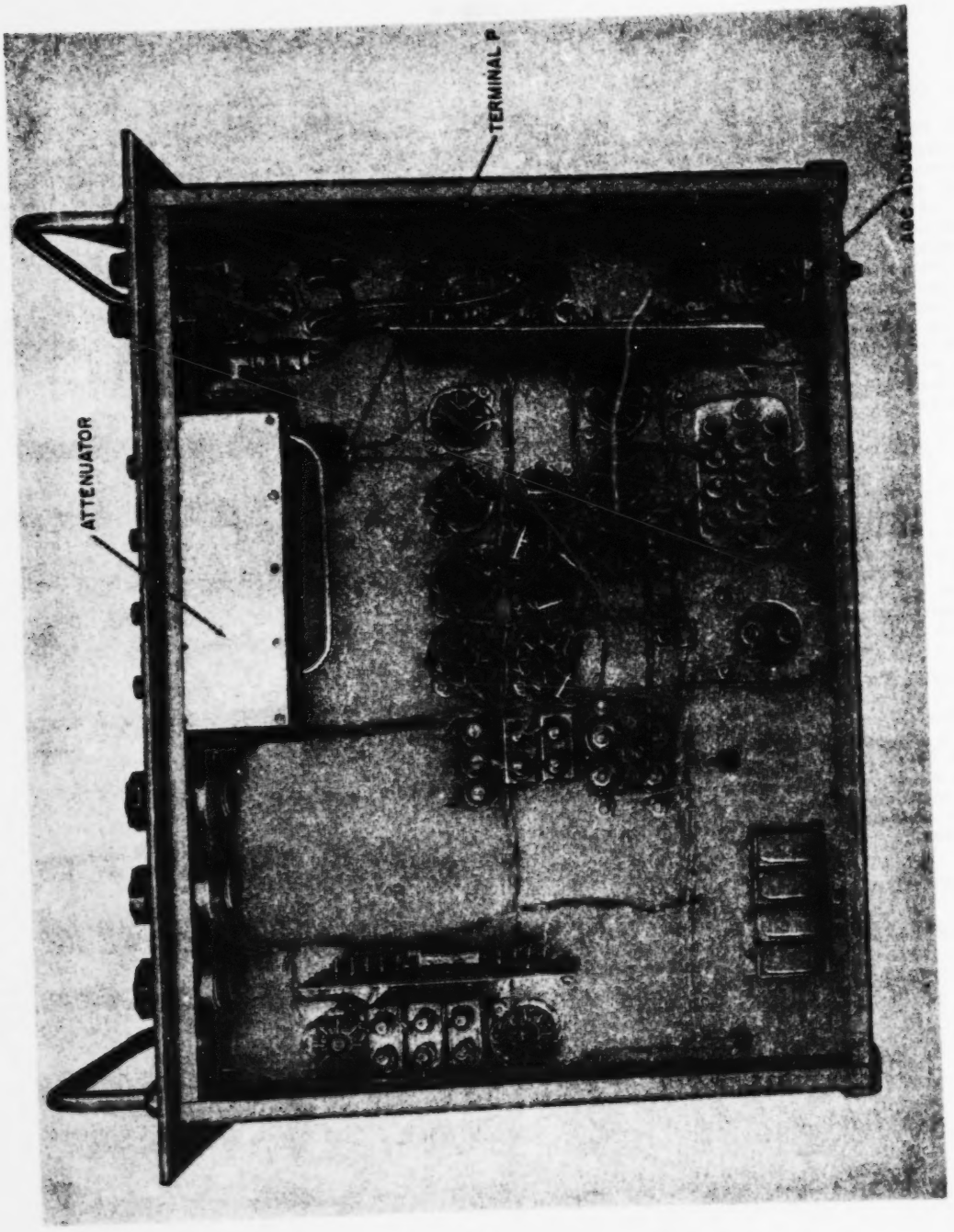

Figure 6-1. Signal Generator TS-452D/U, Bottom View with Protective Case Removed

Table VI. Minimum Performance Standards (Sheet 1 of 4)

Operation	Step	Action	Normal Indication
AC power input	1	Plug into available AC power source. **CAUTION** Do not connect the unit into a DC source of power or to an AC source of power of more than 127 volts or less than 50 CPS. To do so would result in damage.	
	2	Set POWER switch to ON position.	POWER pilot lamp goes on.
Cathode-ray oscilloscope	1	Allow unit to warm up for about 2 minutes.	
	2	Adjust INTENSITY control for brightness desired.	Brightness of spot which appears on screen should vary.
	3	Adjust FOCUS control for desired focus.	Focus sharpness of spot should vary.
	4	Adjust HORIZ CENTER control and VERT CENTER control.	Centering of spot on screen can be varied.
Sweep generator	1	Adjust HOR. AMP. control for increased horizontal sweep on screen.	The length of the horizontal line should be capable of being extended to full width of screen.
Test pattern	1	Insert plug on end of detector probe cable into R.F. INPUT receptacle.	
	2	Place a short lead on signal chuck of probe and secure by making chuck finger tight.	
	3	Insert the lead on the probe into the center hole of the R.F. OUTPUT receptacle.	A rectangular pattern, similar to pattern A, figure 1-7, should appear on the screen.

Table VI. Minimum Performance Standards (Sheet 2 of 4)

Operation	Step	Action	Normal Indication
			Perfect pattern: a. Horizontal lines meet vertical lines. b. Top line parallel to base line. c. Steady pattern.
Wavemeter	1	Turn WAVEMETER BAND SWITCH to the band which will cover the frequencies corresponding to the sweep oscillator output.	
	2	Set WAVEMETER TUNING control to approximately center of scale.	
	3	Adjust MARKER WIDTH control for appearance of dark marker spot on this pattern.	Dark MARKER spot appears on top line of test pattern.
	4	Turn WAVEMETER TUNING control to move dark spot.	Dark spot to be moved to either right or left end of top line in test pattern.
Vertical	1	All previous RF probe and R.F. OUTPUT connections are removed.	
	2	Signal generator unit set up to obtain a horizontal sweep in oscilloscope, as outlined under Cathode-ray oscilloscope and Sweep generator.	
	3	Insert a 6-inch lead wire in center hole of R.F. INPUT receptacle. Hold lead in hand.	A wave form appears on oscilloscope screen.
Multivibrator	1	All previous input connections are removed.	
	2	Set signal generator unit to produce test pattern, as outlined in Test pattern operation column.	Perfect test pattern appears, after adjustments outlined in step 3, Test pattern.

Table VI. Minimum Performance Standards (Sheet 3 of 4)

Operation	Step	Action	Normal Indication
	3	Insert 5-db attenuation by pushing proper panel ATTENUATOR switch.	Amplitude test pattern is reduced.
	4		Pattern after adjustment has dark, steady vertical and horizontal lines.
	5		Perfect test pattern adjustment.
Oscillator	1	Apply AC power to equipment, as described in steps 1 and 2, under AC power input.	
	2	Connect adapter UG-1100/U in series with the probe of an RF vacuum tube voltmeter, to R.F. OUTPUT receptacle.	
	3	Maintain all ATTENUATOR pushbuttons in "out" positions.	Vacuum tube voltmeter should read 250 MV or more.
Attenuator preliminary check	1	No AC power is applied to Signal Generator TS-452D/U.	
	2	Connect ohmmeter, across R.F. OUTPUT receptacle.	
	3	Set all ATTENUATOR switches in "out" position.	75 ± 2 ohms on ohmmeter.
	4	Set all ATTENUATOR switches to the "in" position.	75 ± 2 ohms on ohmmeter.
	5	Remove the input cable from the RF input connector on the ATTENUATOR.	
	6	Press each ATTENUATOR switch to "in" position in sequence; remaining seven switches are in "out" position. At each switch make measurements with ohmmeter connected as follows: a. From input to chassis. b. From output to chassis. c. From input to output.	Refer to Table VII for correct values.

Table VI. Minimum Performance Standards (Sheet 4 of 4)

Operation	Step	Action	Normal Indication
Attenuator operation	1	Apply AC power to Signal Generator TS-452D/U as outlined in steps 1 and 2 under AC power input.	
	2	Select an oscillator frequency with SWEEP OSCILLATOR BANDSWITCH.	
	3	Connect a voltmeter across R.F. OUTPUT receptacle.	
	4	Set all ATTENUATOR switches to out position.	Reading not less than 250 MV.
	5	Push various attenuator switches to the IN position both individually and in combinations. Measure the voltage for each set of positions and compare the measured value with the output which should be obtained.	Refer to figure 6-2 for proper voltage for a given amount of attenuation.

Table VII. Attenuator Check Resistances

Switch Position	Nominal Resistance	
	Input or Output to Chassis (Ω)	Input to Output (Ω)
1 DB in	654.7	8.67
2 DB in	331.3	17.3
3 DB in	225.5	25.8
5 DB in	144.0	42.0
10 DB in	91.5	77.8
20 DB in	76.3	121.6
30 DB in	75.1	141.5
30 DB in	75.1	141.5

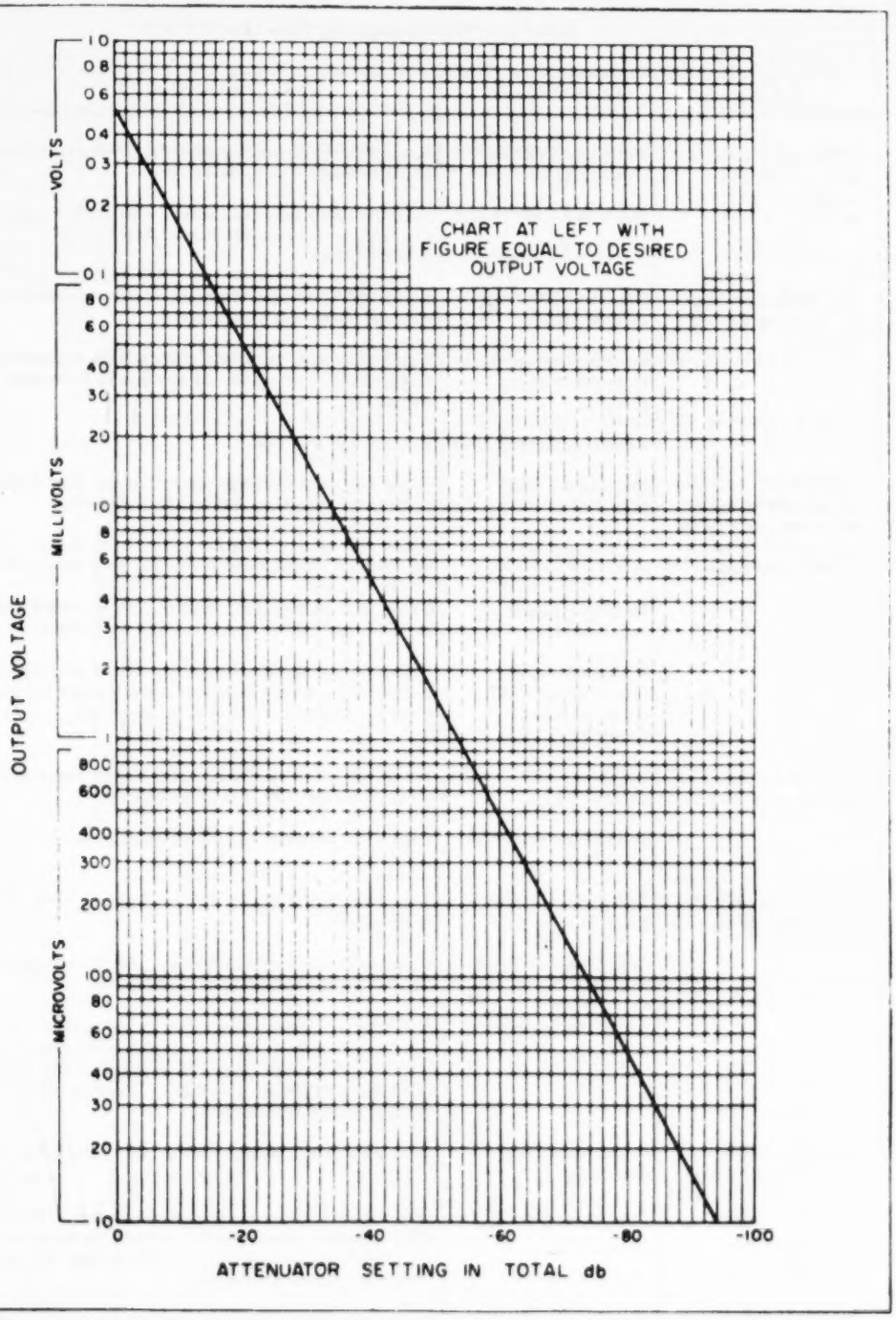

Figure 6-2. Output Voltage versus Attenuator Setting

Table VIII. Troubleshooting Table (Sheet 1 of 2)

Trouble	Probable Cause	Remedy
INTENSITY control has no effect on brightness of display.	Defective INTENSITY control R141.	Using volt-ohm-milliammeter, check resistance of R141. Replace R141 if it is defective.
	Defective CRT (V103)	Using vacuum tube voltmeter, check for cathode (pin 2) to grid (pin 3, 5, or 9) short. Replace CRT (V103) if it is defective.
FOCUS control has no effect on display.	Defective FOCUS control R143.	Using volt-ohm-milliammeter, check resistance of R143. Replace R143 if it is defective.
	Incorrect or missing voltages in focus circuit.	Using volt-ohm-milliammeter, check resistances R142, R143, R146, and R147. If any one is defective, replace it.
	Defective CRT (V103)	Replace CRT (V103).
POWER ON indicator lamp does not light and signal generator is inoperative when POWER switch is operated.	Defective 2 AMP fuse F101.	Using volt-ohm-milliammeter, check fuse F101 for continuity. Replace F101 if it is defective.
	Defective power cord.	Using volt-ohm-milliammeter, check power cord for continuity. Repair power cord if it is defective.
	Defective power switch S101.	Using volt-ohm-milliammeter, check POWER switch S101 in "ON" and "OFF" positions for continuity.
	Defective power transformer T101 (open primary winding)	Using volt-ohm-milliammeter, check primary winding (terminals 1 and 2) of power transformer for continuity. Replace T101 if it is defective.
HOR AMP control has little or no effect	Defective HOR. AMP. control R17.	Using volt-ohm-milliammeter, check resistance of R17. Replace R17 if it is defective.
	Defective horizontal amplifier.	Test V4. Replace V4 if it is defective.
There is little or no vertical deflection on CRT.	Defective vertical amplifier.	Test V101 and V102. Replace V101 or V102 if it is defective.
	Defective VERT. AMP. control.	Using volt-ohm-milliammeter, check resistance of R101. Replace R101 if it is defective.
	Defective detector probe.	Perform procedure described in paragraph 7-4. If results prove that vertical amplifier is operating correctly, use volt-ohm-milliammeter and check resistance of CR201 and R202. Replace CR201 or R202 if either is defective.
There is little or no RF output voltage at R. F. OUTPUT jack with all attenuator switches in the out position.	Defective sweep oscillator	Test V5 and V6; replace V5 or V6 if either is defective.
	Defective attenuator.	Disconnect input connector to attenuator. Using an RF voltmeter, measure RF voltage on input connector removed from attenuator. If RF voltage is present, repair or replace attenuator.
There is no display on cathode-ray tube.	Defective sweep oscillator	Using volt-ohm-milliammeter, check resistance of CR1. Replace CR1 if it is defective.

Table VIII. Troubleshooting Table (Sheet 2 of 2)

Trouble	Probable Cause	Remedy
There is extreme nonlinearity in test pattern.	Defective sweep oscillator circuit	Using volt-ohm-milliammeter, check for ground connection to detector probe chuck.
		Test V2 and V5. Replace V2 or V5 if either is defective.
There is insufficient SWEEP WIDTH	Defective sweep oscillator circuit	Test V2 and V5. Replace V2 or V5 if either is defective.
		Using volt-ohm-milliammeter, check resistance of R22 and R23. Replace R22 or R23 if either is defective.
No marker is presented on CRT display.	Defective V401 or V402	Test V401 and V402. Replace V401 or V402 if either is defective.
	Defective C406	Using volt-ohm-milliammeter, check C406 or bridge C406 with a replacement capacitor. Replace C406 if it is defective.
	Defective C120	Repeat preceding procedures, however, use applicable capacitor.
MARKER WIDTH control has no effect on width of marker.	Defective MARKER WIDTH control	Using volt-ohm-milliammeter, check resistance of R410. Replace R410 if it is defective.

Table IX. Voltage and Resistance Measurements (Sheet 1 of 8)

A 20,000-ohms-per-volt VOM was used for these readings.
An electron-tube socket is necessary for checking voltage and resistances for adapter V6.
N.C.: no external connection.
K 1000.
M 1,000,000.

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measurement	Scale	Measurement	Scale
Electron Tube V1					
1	Plate	+147	0–250	65K	R x 10,000
2	Grid	-56	0–250	1M	R x 10,000
3	Cathode	0	0.250	0	R x 10,000
4	Heater	6.3[a]	0.250	1	R x 1
5	Heater	6.3[a]	0–250	1	R x 1
6	Plate	+140	0–250	70K	R x 10,000
7	Grid	-50	0–2.5	1M	R x 10,000
8	Cathode	0	0–10	0	R x 1
9	Heater	0		0	R x 1

[a] AC voltage

Table IX. Voltage and Resistance Measurements (Sheet 2 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measure-ment	Scale	Measure-ment	Scale
		Electron Tube V2			
1	Plate	150	0–250	65K	R x 10K
2	Grid	-4	0–10	1 MEG	R x 10K
3	Cathode	0	0–2.5	0	R x 1
4	Heater	6.3[a]	0–10	0.1	R x 1
5	Heater	6.3[a]	0–10	0.1	R x 1
6	Plate	275	0–500	180K	R x 10K
7	Grid	200	0–250	300K	R x 10K
8	Cathode	200	0–250	∞	R x 10K
9	Heater	0	0–2.5	0	R x 1
		Electron Tube V3			
1	Plate	+115	0–250	200K	R x 10,000
2	Grid	0	0–250	300K	R x 10,000
3	Cathode	0	0–10	290	R x 10
4	Heater	6.3[a]	0–2.5	.1	R x 1
5	Heater	6.3[a]	0–250	.1	R x 1
6	Plate	+200	0–250	300K	R x 10,000
7	Grid	-4	0–50	600K	R x 10,000
8	Cathode	0		0	R x 1
9	Heater	0		0	R x 1
		Electron Tube V4			
1	Plate	+100	0–250	150K	R x 10K
2	Grid	-100	0–250	800K	R x 10K
3	Cathode	-115	0–250	40K	R x 10K
4	Heater	6.3[a]	0–10	0.1	R x 1
5	Heater	6.3[a]	0–10	0.1	R x 1
6	Plate	100	0–250	150K	R x 10K
7	Grid	-120	0–250	35K	R x 10K
8	Cathode	-115	0–250	40K	R x 10K
9	Heater	0	0–2.5	0	R x 1

[a] AC voltage

Table IX. Voltage and Resistance Measurements (Sheet 3 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measurement	Scale	Measurement	Scale
Electron Tube V5					
1	N.C.				
2	Heater	0[a]	0–2.5	0	R x 1
3	Plate	275	0–500	20K	R x 10K
4	Screen Grid	275	0–500	20K	R x 10K
5	Grid	4.5	0–10	1 MEG	R x 10K
6	N.C.				
7	Heater	6.3[a]	0–10	0.1	R x 1
8	Cathode	25	0–50	2000	R x 10
Electron Tube V6					
1	Plate	200	0–500	∞	R x 10K
2	Grid	-15	0–50	350K	R x 10K
3	Cathode	0	0–2.5	0	R x 1
4	Heater	0	0–2.5	0.1	R x 1
5	Heater	0	0–2.5	0.1	R x 1
6	Plate	190	0–250	∞	R x 10K
7	Grid	-15	0–50	350K	R x 1
8	Cathode	0	0–2.5	0	R x 1
9	Heater	6.3[a]	0–10	0.1	R x 1
Electron Tube V101					
1	Grid	0	0–2.5	20K	R x 100
2	Plate	46.0	0–50	100K	R x 10,000
3	Cathode	0.80	0–2.5	430	R x 100
4	Grid	0	0–2.5	510K	R x 10,000
5	Plate	14.5	0–50	350K	R x 10,000
6	Cathode	0.75	0–2.5	3.9K	R x 100
7	Heater	0	0–2.5	0	R x 1
8	Heater	6.3[a]	0–10	.1	R x 1

(Measurements were taken on V6 with a tube-socket adapter)

[a]AC voltage

Table IX. Voltage and Resistance Measurements (Sheet 4 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measure-ment	Scale	Measure-ment	Scale
Electron Tube V102					
1	Grid	0	0–2.5	510K	R x 10,000
2	Plate	172	0–250	85K	R x 10,000
3	Cathode	7.5	0–10	70K	R x 10,000
4	Grid	0	0–2.5	0	R x 1
5	Plate	170	0–250	85K	R x 10,000
6	Cathode	7.5	0–10	70K	R x 10,000
7	Heater	0	0–2.5	0K	R x 1
8	Heater	6.3[a]	0–10	.1	R x 1
Electron Tube V103					
1	Heater	1100	0–5000	1.75M	R x 10,000
2	Cathode	1100	0–5000	1.75M	R x 10,000
3	Control Grid	1130	0–5000	1.80M	R x 10,000
4	N.C.			∞	R x 10,000
5	Focusing Anode	760	0–1000	1.3M	R x 10,000
6	N.C.			∞	R x 10,000
7	V.D. plate	0	0–2.5	4.0M	R x 10,000
8	V.D. plate	0	0–2.5	4.0M	R x 10,000
9	Accelerating anode	0	0–2.5	0	R x 1
10	H.D. plate	0	0–2.5	4.0M	R x 10,000
11	H.D. plate	0	0–2.5	4.0M	R x 10,000
12	N.C.			∞	R x 10,000
13	N.C.			∞	R x 10,000
14	Heater	1100	0–5000	1.75M	R x 10,000
Electron Tube V104					
1	N.C.		0–5000	∞	R x 10,000
2	Filament			1.45K	R x 100
3	N.C.			∞	R x 10,000
4	N.C.			∞	R x 10,000
5	N.C.			∞	R x 10,000
6	N.C.			∞	R x 10,000

Table IX. Voltage and Resistance Measurements (Sheet 5 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measurement	Scale	Measurement	Scale
		Electron Tube V104 (cont.)			
7	Filament	1130[a]	0–5000	1.45K	R x 100
8[b]	N.C.	1130[a]	0–5000	1.45K	R x 100
Cap	Plate	1300	0–5000	2M	R x 10,000
		Electron Tube V105			
1	N.C.			∞	R x 10,000
2	Heater	0	0–2.5	0	R x 1
3	Plate		0–250	85	R x 1
4	N.C.			∞	R x 10,000
5	Plate	250	0–250	88	R x 1
6	N.C.			∞	R x 10,000
7	Heater	6.3[a]	0–10	0.1	R x 1
8	Cathode	295	0–1000	40K	R x 10,000
		Electron Tube V106			
1	N.C.			∞	R x 10,000
2	Heater	0	0–2.5	0	R x 1
3	Plate	-192	0–250	35K	R x 10,000
4	N.C.			∞	R x 10,000
5	Plate	-192	0–250	35K	R x 10,000
6	N.C.			∞	R x 10,000
7	Heater	6.3[a]	0–10	.1	R x 1
8	Cathode	245	0–250	88	R x 1
		Electron Tube V107			
1	N.C.			∞	R x 10,000
2	Cathode	-140	0–250	34K	R x 10,000
3	N.C.			∞	R x 10,000
4	N.C.			∞	R x 10,000
5	Plate	0	0–2.5	0	R x 1

[a] AC voltage

[b] Internal connection between terminals 7 and 8. All resistance readings are from point indicated to chassis

Table IX. Voltage and Resistance Measurements (Sheet 6 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measurement	Scale	Measurement	Scale
		Electron Tube V107 (cont.)			
6	N.C.			∞	R x 10,000
7	N.C.			∞	R x 10,000
8	N.C.			∞	R x 10,000
		Electron Tube V108			
1[d]	N.C.			∞	R x 10,000
2	Cathode	-140	0–250	35K	R x 10,000
3	N.C.			∞	R x 10,000
4	Tiepoint	-140	0–250	35K	R x 10,000
5	Plate	0	0–2.5	0	R x 1
6	Tiepoint	+130	0–250	70K	R x 10,000
7	N.C.			∞	R x 10,000
8	Tiepoint	+150	0–250	20K	R x 10,000
		Electron Tube V401			
1	Grid	0	0–2.5	200K	R x 10,000
2	Plate	285	0–1000	550K	R x 10,000
3	Cathode	0	0–2.5	2.2K	R x 100
4	Grid	0	0–2.5	300K	R x 10,000
5	Plate	275	0–1000	35K	R x 10,000
6	Cathode	0	0–2.5	0	R x 1
7	Heater	0	0–2.5	0	R x 1
8	Heater	6.3[a]	0–10	0.1R	R x 1
		Electron Tube V402			
1	Grid	0	0–2.5	390K	R x 10,000
2	Plate	275	0–1000	50K	R x 10,000
3	Cathode	5.8	0–10	5.6K	R x 100
4	Grid	0	0–2.5	390K	R x 10,000
5	Plate	285	0–1000	140K	R x 10,000

[d] Terminal 1 on V108 is not internally connected, it is used as a tiepoint.

Table IX. Voltage and Resistance Measurements (Sheet 7 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measure-ment	Scale	Measure-ment	Scale
		Electron Tube V402 (cont.)			
6	Cathode	0	0–2.5	1.3K	R x 100
7	Heater	0	0–2.5	0	R x 1
8	Heater	6.3[4]	0–10	0.1	R x 1
		Wavemeter Terminal Strip			
G	Ground	0	0–2.5	0	R x 1
P	Pulse	0	0–2.5	250K	R x 10,000
B	B+	275	0–1000	20K	R x 10,000
F	Filament		0–10	0.1	R x 1
		Capacitor C102			
1		0	0–2.5	0	R x 1
2				∞	R x 10,000
3		285	0–1000	17K	R x 10,000
4				∞	R x 10,000
5		260	0–1000	19K	R x 10,000
6				∞	R x 10,000
7				∞	R x 10,000
8				∞	R x 10,000
		Capacitor C107			
1		0		0	R x 1
2				∞	R x 10,000
3		60	0–250	110K	R x 10,000
4				∞	R x 10,000
5		60	0–250	110K	R x 10,000
6				∞	R x 10,000
7				∞	R x 10,000
8				∞	R x 10,000
		Capacitor C110			
1		-165	0–250	26K	R x 10,000
2				∞	R x 10,000

Table IX. Voltage and Resistance Measurements (Sheet 8 of 8)

Terminal		Voltage		Resistance (Ω)	
No.	Name	Measure-ment	Scale	Measure-ment	Scale
Capacitor C110 (cont.)					
3		0	0–2.5	0	R x 1
4				∞	R x 10,000
5		0	0–2.5	0	R x 1
6				∞	R x 10,000
7				∞	R x 10,000
8				∞	R x 10,000
Capacitor C111					
1		0	0–2.5	0	R x 1
2[e]		260		19K	R x 10,000
3		275	0–1000	17K	R x 10,000
4[e]		275		17K	R x 10,000
5		275	0–1000	17K	R x 10,000
6				∞	R x 10,000
7				∞	R x 10,000
8				∞	R x 10,000
Capacitor C114					
1		-150	0–250	30K	R x 10,000
2				∞	R x 10,000
3		0	0–2.5	∞	R x 10,000
4				∞	R x 10,000
5		0	0–2.5	∞	R x 10,000
6				∞	R x 10,000
7				∞	R x 10,000
8				∞	R x 10,000

[e] Tiepoint.

SECTION VII

CALIBRATION

7-1. GENERAL.

7-2. This section contains (1) information required for performing the calibration which is necessary for checking the reliability of the signal generator and (2) the procedures for performing corrective maintenance.

7-3. VERTICAL AMPLIFIER CHECK.

7-4. Operate the signal generator to obtain a horizontal sweep on the CRT screen, as described in paragraph 4-8, steps a through l. Insert a lead about 6 or 8 inches long in the center hole of the INPUT receptable. If a wave form appears on the screen when the lead is held in the hand, the vertical amplifier is operating.

7-5. SWEEP OSCILLATOR CHECK.

7-6. Turn on the signal generator as described in paragraph 4-8, steps a through l. Connect an RF vacuum-tube voltmeter to the R.F. OUTPUT receptacle, in conjunction with a calibrated detector. With all attenuator switches in the out position the output should be not less than 250 millivolts across a 75-ohm load.

7-7. If there is no oscillator output, or less than a 250-millivolt output, refer to Section VI for corrective procedures.

7-8. ATTENUATOR TEST.

7-9. A method of checking the attenuation is this: use a correctly calibrated standard attenuator connector in series with the R.F. OUTPUT receptacle, in conjunction with an RF voltmeter. Perform the check as follows:

a. With no attenuation on the signal generator, and with a given amount on the standard attenuator, read the output voltage on the calibrated detector.

b. Add a given amount of attenuation, using the signal generator attenuator. Subtract the same amount from the standard attenuator and again read the calibrated detector.

c. If the same reading is obtained on the RF voltmeter as was obtained in step a, the signal generator attenuator is correct for the attenuation step being tested. If the reading is not the same, adjust the standard attenuator until the reading is the same. The difference between the amount of attenuation added to the signal generator attenuator and the amount subtracted by the standard attenuator (original subtraction plus adjustment) is the amount (and direction) of error.

d. Repeat the operations described in steps a through c for other amounts of attenuation to obtain a complete test of the attenuator. If the attenuator error is 0.5 db or more, replace the defective resistors or make proper allowance when you use the signal generator.

7-10. WAVEMETER CALIBRATION CHECK.

7-11. The two methods of calibration check are described here.

7-12. VISUAL METHOD.

7-13. A simple and fairly accurate method of checking the calibration of the wavemeter follows:

a. Plug the output cable into the R.F. OUTPUT receptacle and attach the terminating resistor to the other end of the output cable (figure 7-1).

b. Connect leads from the chucks of the detector probe to the terminating resistor. Also connect the output of a calibrated signal generator and a frequency counter to these leads.

c. Select the signal-generator frequency and WAVEMETER BANDSWITCH frequency setting for the frequency to be tested. Operate the signal generator as described in paragraph 4-8, steps a through l. Insert the plug on the end of the detector probe cable into the INPUT receptacle.

d. If the equipment is operating properly, a rectangular pattern will appear on the screen of the oscilloscope with a dark dot corresponding to the wavemeter setting. Also, on the upper horizontal line to the pattern a short series of oscillations or "pip" will appear. The pip represents the frequency of the calibrated signal generator.

e. Set the wavemeter TUNING control to the frequency being checked and adjust the signal source until the center of the pip coincides with the left edge of the blanking spot. If the adjustments have been made carefully, the frequency meter reading and frequency counter reading will indicate correctly the frequency at which the wavemeter is set. For a correctly calibrated wavemeter, the wavemeter reading will be within 1 per cent of the frequency counter reading.

f. Repeat the operations described in step e for other frequencies to obtain a check over the range of the wavemeter.

CAUTION

If the wavemeter is found to be inaccurate, do not open the wavemeter case for adjustment in the field. An attempt to remove the gear or adjust the tuning circuit will necessitate a precision recalibration.

7-14. ZERO-BEAT METHOD.

7-15. A method of checking the calibration of the wavemeter which is more accurate than that described in paragraph 7-10 is given here.

a. Make an electron tube adapter by connecting all the terminals on an octal socket to the corresponding pins on an octal tube base and connect an 0.01-microfarad capacitor across pins 5 and 1. Remove tube V402 from its socket; plug the adapter into this socket and insert tube V402 into the adapter.

Note

The adapter increases the value of capacitor C405 so that the differentiating action is lost and more gain is available.

b. Disconnect the wavemeter input coaxial lead and the output lead (terminal P on terminal board) (figure 6-1). Connect the output of an auxiliary signal generator to the input of the wavemeter, and loosely couple an auxiliary signal source to the signal generator. Modulate the signal generator at 400 or 1000 cps.

c. Measure the output of the wavemeter with a pair of headphones or a vacuum-tube voltmeter capable of measuring signals in the millivolt range.

d. Set the wavemeter TUNING control to the frequency being checked. Vary the frequency of the auxiliary signal generator until a resonant point is reached (output from wavemeter is maximum). Read the frequency on the frequency counter and compare with the wavemeter reading. If the wavemeter is within 1 per cent of the frequency meter reading, the calibration is satisfactory.

e. Repeat the operations described in step d for other frequencies to obtain a check over the range of the wavemeter.

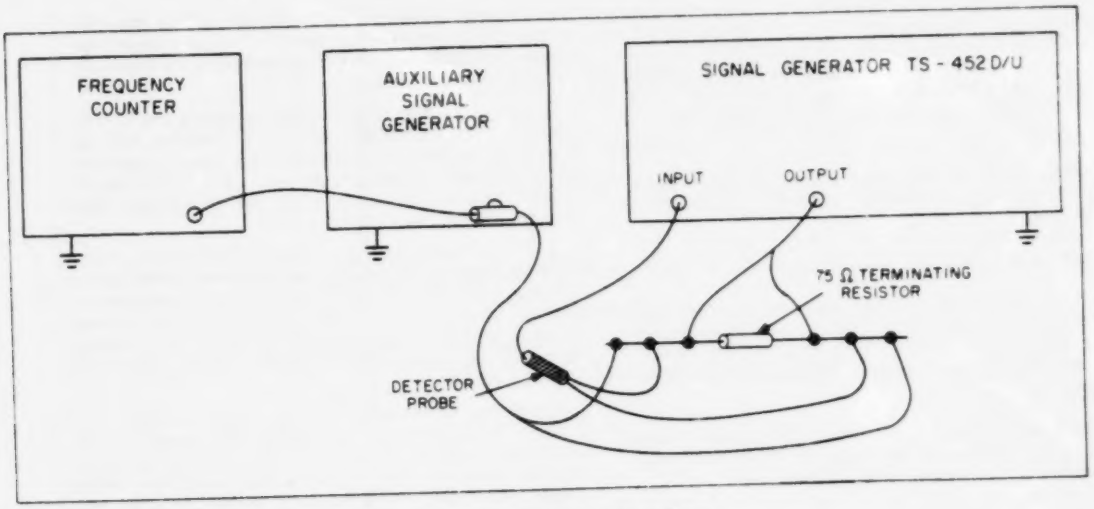

Figure 7-1. Wavemeter Test Setup

SECTION VIII
DEPOT OVERHAUL STANDARDS

8-1. Applicability of Depot Overhaul Standards

The tests outlined in this section are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

8-2. Applicable References

a. Repair Standards. Applicable procedures of the Depot performing these tests and the general standards given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 for repaired electronic equipment form a part of the requirements for testing this equipment.

b. Technical Publications. TM 11-6625-283-12 is the only other manual applicable to this equipment.

c. Modification Work Orders. Perform all the modification work orders applicable to this equipment *before* making the tests specified. DA Pam 310-7 lists all available MWO's.

8-3. Test Facilities Required

The equipment listed below is required for depot testing:

Item	*Technical manual*	*Common name*
Counter, Electronic, Digital Readout AN/USM-207 A	TM 11-6625-700-10	Electronic counter.
or		
Frequency Meter AN/USM-26	TM 11-5057	Frequency meter.
Signal Generator AN/USM-44	TM 11-6625-508-10	Signal generator.
Multimeter AN/USM-223	TM 11-6625-654-14	Multimeter
Multimeter ME-26 (*)/U *	TM 11-6625-200-12	Multimeter.

* Multimeter ME-26 (*)/U represents Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.

8-4. General Test Conditions

All tests should be conducted under the following conditions:

a. At normal room temperature.

b. Input power, 115 volts, 60 cycles per second (cps), single-phase alternating current (ac).

c. All tests should be made with Adapter UG-1100/G connected to the radiofrequency (rf) output.

8-5. Electrical Requirements

a. Controls Check. All controls should be tested in accordance with the instructions given in table V.

b. Oscillator Output. The voltage measured at the R.F. OUTPUT receptacle with all ATTENUATOR switches set to OUT should be at least 0.254 at frequency settings of 5, 30, 60, and 100 mc to 0.25 volt for each of the oscillator coils with the sweep meter in the on position.

c. Wavemeter. Connect Signal Generator TS-452D/U to the test equipment as shown in figure 8-1. Measure the frequency of the wavemeter every 1 megacycle (mc) over the entire band A, every 2 mc over band B, every 5 mc over band C, and every 10 mc over band D. When measuring the wavemeter frequency, follow the instructions given in paragraph 7-10.

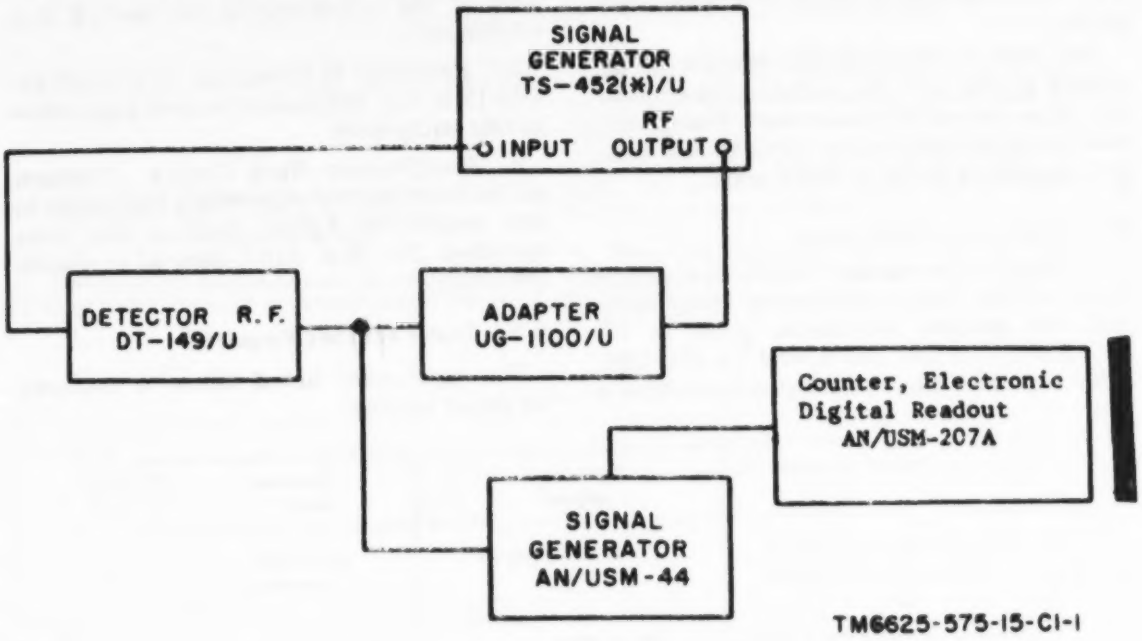

Figure 8-1. Wavemeter calibration test

d. Connect the ME-26 (*)/U across the R.F. OUTPUT receptacle. Adjust the signal generator output to 5 mc. Measure the output voltage with no attenuation (reference). Measure the output voltage with the ATTENUATION switches pressed as listed in the chart below. The ratio of these measured voltages to the reference voltage should be within the limits shown in the chart.

Switch	*Voltage ratio limits*
1 db	0.91 to 0.87
2 db	0.81 to 0.78
3 db	0.72 to 0.69
1, 2, and 3 db	0.54 to 0.47
5 and 1 db	0.54 to 0.46

e. Connect the ME-26(*)/U probe to the R.F. OUTPUT receptacle. Insert 10-db attenuation set VERT. AMP. gain control at maximum. Mark the top and bottom of the trace on the face of the scope. Remove the 10db attenuation. Insert 5-, 3-, and 2db attenuation, respectively. The trace should remain the same height as marked.

APPENDIX I
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 9-213	Painting Instructions for Field Use.
TM 11-6625-200-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools): Multimeters ME-26A/U (FSN 6625-360-2493), ME 26B/U, ME 26C/U (FSN 6625-646-9409), and ME 26D/U (FSN 6625-913-9781).
TM 11-6625-283-12	Operator and Organizational Maintenance Manual: Signal Generators TS-452B/U and TS-452C/U.
TM 11-6625-475-10	Operator's Manual: Multimeters AN/PSM-6, AN/PSM-6A, and AN/PSM-6B.
TM 11-6625-508-10	Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 11-6625-654-14	Operator's Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools Lists) for Multimeter AN/USM-223.
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207
TM 38-750	The Army Maintenance Management System (TAMMS)

APPENDIX II
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

This appendix provides a summary of the maintenance operations for the TS-452D/U and TS-452E/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army Equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function

listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C — Operator/Crew
O — Organizational
F — Direct Support
H — General Support
D — Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

4. Tool and Test Equipment Requirements (Table 1)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II MAINTENANCE ALLOCATION CHART FOR GENERATOR, SIGNAL TS-452D/U AND TS-452E/U

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT
			C	O	F	H	D	
00	GENERATOR, SIGNAL TS-452D/U AND TS-452E/U	Inspect		0.2				
		Test				0.7		1,2,3,5,6,7
		Service		0.4				8
		Adjust				0.4		1,2,3,5,6,7
		Repair		0.2				8
		Repair				0.5		7
		Rebuild					2.0	1,2,3,4,6,7

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR GENERATOR, SIGNAL TS-452D/U AND TS-452E/U

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	COUNTER, ELECTRONIC, DIGITAL READOUT AN/USM-207A	6625-00-911-6368	
2	H,D	GENERATOR, SIGNAL AN/USM-44	6625-00-669-4031	
3	H,D	MULTIMETER AN/USM-223	6625-00-999-7465	
4	D	TEST SET, ELECTRON TUBE TV-2/U	6625-00-669-0263	
5	H	TEST SET, ELECTRON TUBE TV-7/U	6625-00-820-0064	
6	H,D	MULTIMETER ME-26D/U	6625-00-913-9781	
7	H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
8	O	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE ORGANIZATIONAL REPAIRMAN BECAUSE OF HIS ASSIGNED MISSION		

APPENDIX III
BASIC ISSUE ITEMS LIST (BIIL) AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)

Section I. INTRODUCTION

1. Scope

This appendix lists basic issue items required by the crew/operator for installation, operation, and maintenance of these equipments.

2. General

This Basic Issue Items and Items Troop Installed or Authorized List is divided into the following sections:

a. Basic Issue Items List-Section II. A list, in alphabetical sequence, of items which are furnished with, and which must be turned in with the end item.

b. Items Troop Installed or Authorized List-Section III. Not applicable.

3. Explanation of Columns

The following provides an explanation of columns found in the tabular listings:

a. Illustration. Not applicable.

b. Federal Stock Number. Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

d. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc., and is identified in SB 708-42.

e. Description. Indicates the Federal item name and a minimum description required to identify the item.

f. Unit of Measure (U/M). Indicates the standard of basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, (e.g., ea, in., pr, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

g. Quantity Furnished with Equipment (Basic Issue Items Only). Indicates the quantity of the basic issue item furnished with the equipment.

4. Special Information

Identification of the usable on codes of this appendix are:

Code	Used in
1	TS-452B/U
2	TS-452C/U
3	TS-452D/U

Section II. BASIC ISSUE ITEMS LIST

(1) Illustration: (A) Fig. No.	(B) Item No.	(2) Federal stock number	(3) Part number	(4) RSV	(5) Description: Usable on code	(6) Unit of meas	(7) Qty furn with equip
		6625-00-041-0228			CASE TRANSIT CY-1618U (INCL COVER) 123	EA	1

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USA Elct RD Actv, Ft Huachuca (2)
USARSOUTHCOM Sig Agcy (1)
Sig Fld Maint Shop (3)
Units org under fol TOE:
Two copies each UNOINDC:
11-7
11-16
11-57
11-98
11-117
11-155
11-157
11-500 (AA-AE) (4)
11-557
11-587
11-592
11-597
32-57
55-157

NG: State AG (3); units—same as Active Army except allowance is one copy each unit.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

PIN : 017333-000

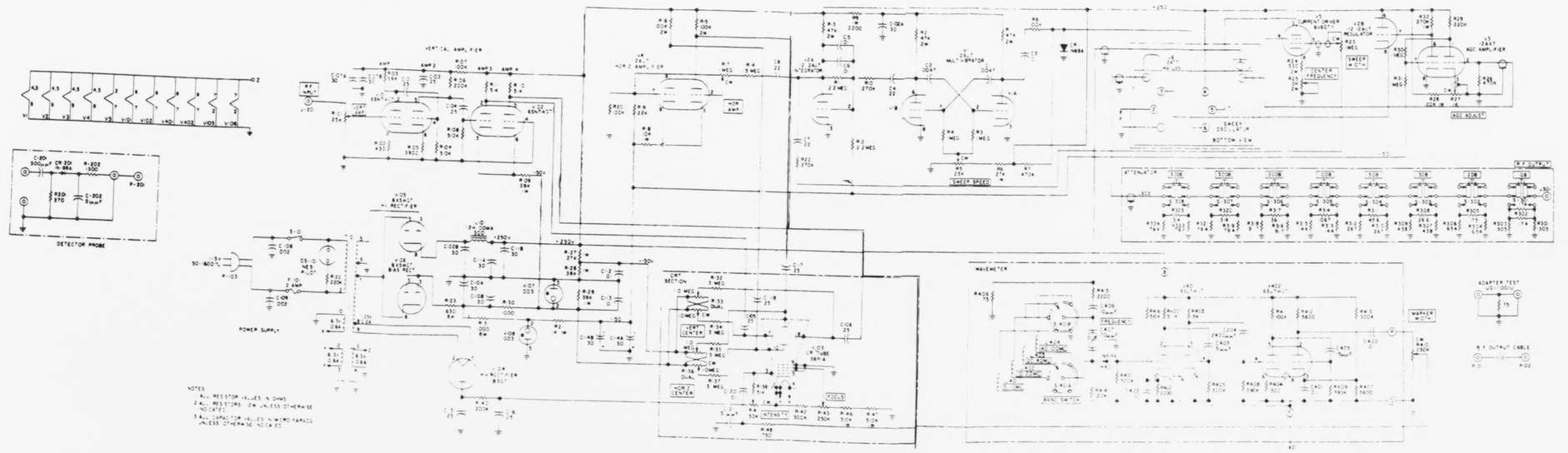

Figure 1-16. Signal Generator TS-452D/U, Schematic Diagram

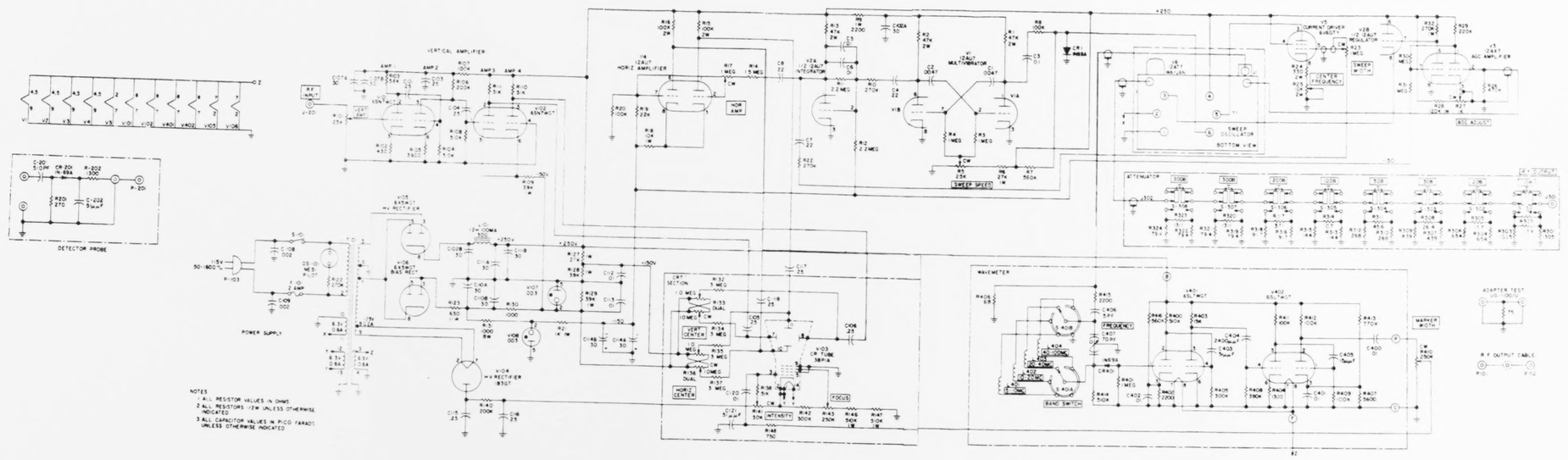

Figure 1-17. Signal Generator TS-452E/U, schematic diagram

FIGURE 1-17. SIGNAL GENERATOR TS-452E/U, SCHEMATIC DIAGRAM